THE IRON TRADE REVIEW

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Plant Activities Are Increasing

Corporation and Other Companies Will Increase Production— Prices of Leading Products Higher

ACTIVITIES of the United States Steel Corporation are steadily increasing. Its plants are now running at slightly under 85 per cent of ingot capacity, which will be augmented by additions now planned, including resumption at the North Sharon plant of the Carnegie Steel Co. and the Columbus works. Bookings of the Corporation are keeping ahead of its heavy shipments. Good reports also come from leading independents. Foreign inquiry for rails is still heavy and there is excellent prospect of closing at least 200,000 tons. The trend of prices of leading steel products, especially shapes, plates and bars, is upward, although there are still some irregularities. As illustrating the tendency to ask higher prices for future delivery, the quoting of 1.30c, Pittsburgh, on 24,000 tons for the municipal bridge at St. Louis by a leading company may be cited. Delivery of this steel will extend well into next year. Several Youngstown manufacturers have advanced quotations for prompt and future delivery of billets and sheet bars.

Iron Ore

Although the lake ore trade drags, some eastern companies will use greater tonnages of Lake Superior ore than in recent years. One company has arranged for a tonnage of lake ore to be furnished through another steel company in place of Cuban ore, on account of the increased difficulty in obtaining shipments from Cuba.

Machinery

The movement toward higher prices on machine tools has become more general and is having the effect of checking railroad buying. The Santa Fe, after closing for a few lathes, has withdrawn the remainder of its inquiry. The French government is inquiring for a large number of lathes and milling machines, estimated to be about 1,000 each, and Italy is asking for 500 lathes. These and other foreign inquiries are not receiving much attention on account of many manufacturers being booked to capacity for three or four months. The placing of orders for mill equipment for the manufacture of steel bars by the Youngstown Sheet & Tube Co. marks another step in the progress of that company, which has been rapid in recent years.

Railroad Buying

Railroads in the United States have been ordering somewhat more freely and further buying by Russia and other foreign countries is in prospect. The receivers for the Rock Island have ordered 4,000 steel underframe box cars and the Lake Superior & Ishpeming, which recently placed 500 freight cars, has closed for 406 ore cars. At Cleveland, inquiries have appeared from the New York Central for 10,750,000 bolts, 3,000 tons of plates, 750 tons of shapes and 250 tons of bars. The Lake Erie & Western is in the market for 238,000 bolts and 40 tons of nuts. Inquiries for spikes include 30,000 kegs for the New York Central, 20,000 for the Baltimore & Ohio, 2,000 for the Lehigh & New England and 1,000 for the Wheeling & Lake Erie. France is inquiring for large tonnages of steel rails

Plates

Ship building continues to be a most interesting feature in the eastern situation. Two more vessels have been awarded to the Atlantic ship yards, and still more contracts are pending. It now seems probable that the fleet of five vessels ordered by the Bethlehem Steel Co., to be built in British yards before the war, will be constructed in this country. These vessels are to be used in carrying iron ore from the company's mines in Chili. The government is inquiring for 2,250 tons of plates for the collier CUYAMA, to be built on the Pacific coast.

Pig Iron

A valley interest has taken an order for 1,000 tons of bessemer pig iron for shipment to Italy. A car wheel manufacturer has ordered from 5,000 to 6,000 tons of foundry grades for shipment over the last half. While in some centers more interest is being shown in requirements for the first half of next year, very little buying for any delivery is being done, but shipments are satisfactory.

THE OPEN HEARTH

Danger of Going Too Far

AN EXTREMELY interesting development in the relations of the government to business is indicated by the present attitude of the newly created federal trade commission. The members of this commission realize that muck-raking and opposition to business are not as popular as in past years and that if the commission hopes to accomplish anything that is worth while, it will be well for it to co-operate with legitimate business concerns. This is highly commendable, as is also the attitude of the chamber of commerce of the United States and other organizations of business men which are doing all in their power to co-operate with the federal trade commission. Some lawyers of good standing, zealous to serve their clients, are, however, urging the commission to go further than it has any right to go in extending advice to business men as to the legality of their business methods and there is some indication that the commission may over-step the bounds of its authority.

As stated in an article by our Washington correspondent, published elsewhere in this issue, James A. Emery, counsel of the National Council for Industrial Defense, has pointed out that the only time when the commission may investigate for the purpose of assisting a corporation to conform to the law is when the attorney general requests the commission to do so, after the corporation is charged with violating an anti-trust act. The statute is intended to assist in the re-adjustment of the business of the corporation alleged to be violating the anti-trust acts in order that the corporation may thereafter conduct its business in accordance with law. We imagine there will be few companies which would care to place themselves in position to obtain recommendations for the "re-adjustment" of their business, but unless they do this, they have no right to expect to obtain useful advice from the commission concerning the legality of their business.

While we believe business organizations ought to co-operate as fully as possible with the commission without endangering their own rights, we believe that reasonable caution should be exercised. Numerous companies in past years have been led to think by officials at Washington that they were conducting their affairs legally and the reward for their frankness in telling all about their affairs and putting themselves to much expense in collecting information for the government was prosecution, if not persecution, at the hands of government officials. The most conspicuous example was furnished by the United States Steel Corporation. No one is anxious to be killed—not even by the kindness of government officials.

The Useful Life of Thomas D. West

THE activities of the late Thomas Dyson West, whose tragic death ended a life of great usefulness, naturally divide themselves into three classes: His business as a foundryman, in which he was successful; his work as an author, for which he was most widely known, and his tireless efforts to advance the cause of safety and other reforms.

As a foundryman, Mr. West was devoted to his work, and the success of his latest business venture was one that brought him much happiness during the last year of his life. But he was not contented to be merely a business man and from the time that as a boy he worked in a foundry he was a student of foundry problems. When it is considered that Mr. West had very little schooling, his success not only as an author of articles and books relating to foundry practice, but also as a writer on other subjects, was indeed remarkable. His writings were based very largely on his own experience and research. He had the courage of his convictions and did not hesitate to be in advance of general practice. In presenting new theories, he urged them with all the intensity of his nature. In the preface of the eleventh edition of his Metallurgy of Cast Iron, Mr. West said: "The author was made to suffer keenly for the bitter criticisms aroused by his writings and the measures he advocated when first contending for what his experience and methods taught were correct and best, but all is now forgotten and buried. He has the gratification of seeing the accomplishment of almost all that he originally contended for and wishes to thank all those who had faith in his teachings." These words are thoroughly characteristic of the man who fought, and fought hard, but with whom bitterness did not linger. In inducing foundrymen to purchase pig iron according to analysis rather than by fracture, and in many other departures, Mr. West rendered service of great importance to the foundry industry. In the American Foundrymen's Association *Journal* of October, 1903, the secretary, Dr. Richard Moldenke, said of Mr. West: "It is but fitting that the first page of our enlarged *Journal* be graced by the portrait of the man who, more than any other, has labored to place the foundry industry on the high plane we find it today. Twenty-three years ago, when he began his aggressive campaign for better foundry education, he little realized how difficult it would be to awaken an industry which today, in spite of all that may be said for it, is still the most backward of the entire iron industry. Perhaps, therefore, he must now feel great satisfaction in seeing the clouds roll by, opposition to advanced ideas disappear, none the less surely because slowly, and his disinterested labors

THE OPEN HEARTH

for the good of the apprentice, the molder, the manager, and the owner, appreciated and extolled.

"Wherever foundrymen congregate, the name of Thomas D. West is heard, his books are to be found in every progressive foundry and in the molder's home, his face is familiar to all. From his early boyhood, Mr. West has been so busily engaged in hard work that only now is he seeing his broad ideas on founding being realized in his own establishment. In enlarging the foundry which makes ingot molds a specialty, and running on the continuous plan, not only is an excellent example of modern foundry equipment given to the world, but an actual capacity of nearly 1,000 tons daily provided for, a thing which will be monumental in the history of the foundry world."

In his later years, Mr. West devoted his time and energy very largely to the prevention of accidents. He was sometimes discouraged, but never disheartened. Although the American Anti-Accident Association which he organized was not continued as such, the work went on and he was an important factor in the rapid progress of the safety movement. An interesting example of his resourcefulness and efficiency was shown in Cleveland in 1909. In the preceding year, the city council passed an ordinance forbidding the sale and use of firecrackers and explosives. Opposition to the ordinance developed in various directions and there was danger of its repeal. Mr. West clearly saw that unless some sort of sane celebration could be devised to take the place of the fun of the old-fashioned Fourth, the ordinance was doomed. Having failed to interest city officials, he appealed to the Daughters of the American Revolution and with their help planned and carried out on the Fourth of July, 1909, a sane celebration which was a great success. After that year, there was no further agitation in favor of repealing the ordinance and similar laws were passed by the legislative bodies of many other cities. Statistics tell the story of how fires, deaths and injuries on the Fourth of July have been almost obliterated by this reform.

Mr. West was one of the first to see clearly that one of the principal causes of accidents in industrial plants is intoxication. In speeches and in articles, he urged the pushing back of the saloon from the neighborhood of foundries and other manufacturing plants and was an ardent advocate of temperance. His last important work was in the cause of safety and the rules and regulations for the prevention of accidents in Ohio foundries which he and his associates recently drafted will doubtless be adopted at an early date by the industrial commission of Ohio.

The death by accident of a man who had labored so zealously for the prevention of accidents is indeed a sad commentary upon present conditions. It shows that, in spite of all efforts, the danger from accident due to automobiles is today greater than ever. May it help in solving the extremely difficult problem of regulating the use of automobiles on the busy street!

Have You Read It?

THE publication in *The Iron Trade Review* of June 10, in full, of the opinions of the United States judges in the case of the government against the United States Steel Corporation has elicited many expressions of approval, including the following:

Editor, The Iron Trade Review:—

I feel that it is due you that I should express my thanks and my appreciation of the special service rendered in respect to the United States court decision covering the Steel Corporation suit.

I took sufficient time to read this decision in full as you printed it, and at the completion felt that the time had been well spent.

The fact of the matter is that the analysis in the daily papers and the other journals gave a somewhat distorted idea of what is the real decision.

Such service as you have rendered to the trade in this instance is, I am sure, thoroughly appreciated.

Very truly yours,

CORRUGATED BAR CO.

By W. M. ARMSTRONG,

Vice President.

Mutual Life Building,
Buffalo, N. Y., June 18, 1915.

Mr. Armstrong makes two points very clear: That the full report is the only report that gives the correct idea of the decision, and that the opinions are well worth the time which it takes to read them. The opinions are, in fact, a mine of information for anyone connected with the iron trade. We commend their reading particularly to the young men who, if they expect to rise to be factors of any importance in the great industry with which they are connected, must know something about how that industry was developed. They will find that the story of the evolution of the Steel Corporation and the progress of its competitors as told by the judges is both fascinating and instructive.

The action of Governor Slaton, of Georgia, in commuting the sentence of Leo Frank was a distinct victory for law and order. Whether Frank was guilty or not, we do not know, but if any further evidence were needed that he did not have a fair trial, it has been furnished during the past few days, for no man could be fairly tried in an atmosphere so bitterly hostile to him as that which prevails at Atlanta.

Prices Present and Past

Quotations on leading products June 23, average for May, 1915, average for March, 1915, and average for June, 1914. Prices are those ruling in the largest percentage of sales at the dates named.

	Prices June 23, 1915.	Average for May, 1915.	Average for March, 1915.	Aver. for June, 1914.
Bessemer pig iron Pittsburgh..	$14.60	$14.55	$14.55	$14.90
Basic pig iron, Pittsburgh.....	13.60	13.45	13.45	13.90
No. 2 Fdy. pig iron, Pittsburgh	13.45	13.45	13.45	13.90
Northern No. 2 Fdy., Chgo....	13.00	13.00	14.25	14.25
Lake Superior Charcoal, Chgo..	15.75	15.25	15.50	15.75
Malleable, Bessemer, Chgo.....	13.00	13.00	14.25	14.25
Southern No. 2, Birmingham...	9.50	9.75	9.50	10.45
Southern Ohio No. 2, Ironton.	12.50	12.50	12.75	13.50
Basic, eastern Pa.....	13.75	13.25	13.50	14.00
No. 2X Virginia furnace.....	12.50	12.50	12.50	12.50
No. 2X foundry, Philadelphia..	14.25	14.25	14.25	14.75
Ferro mang., Balt., (prompt)..	105.00	100.00	78.00	38.00
Billets, Pbgh.	20.00	19.50	19.50	19.75
Sheet bars, Pbgh.....	20.50	20.00	20.00	20.75
Steel bars, Chicago.....	1.39	1.39	1.38	1.28
Steel bars, Pittsburgh.....	1.20	1.20	1.15	1.115
Iron bars, Philadelphia.....	1.17	1.17	1.12	1.17
Iron bars, Cleveland, local del'y	1.20	1.20	1.15	1.20
Iron bars, Chgo, mill.....	1.20	1.15	1.17	1.10

	Prices June 23, 1915.	Average for May, 1915.	Average for March, 1915.	Aver. for June, 1914.
Beams, Chicago	$1.39	$1.34	$1.43	$1.28
Beams, Pittsburgh	1.20	1.20	1.15	1.115
Beams, Philadelphia	1.359	1.359	1.25	1.25
Tank plates, Pittsburgh.....	1.20	1.125	1.125	1.10
Tank plates, Chicago.....	1.34	1.29	1.38	1.28
Tank plates, Philadelphia.....	1.359	1.359	1.259	1.25
Sheets, blk., No. 28, Pittsburgh	1.80	1.80	1.80	1.82
Sheets, blue an., No. 10, Pbgh.	1.35	1.35	1.30	1.35
Sheets, galv., No. 28, Pbgh....	5.00	3.40	3.40	2.77
Wire nails, Pittsburgh.....	1.55	1.55	1.60	1.50
Connellsville fur. coke contr...	1.65	1.65	1.65	1.85
Connellsville fdy. coke, contr...	2.25	2.25	2.25	2.35
Heavy melting steel, Pbgh....	11.75	11.75	12.00	12.00
Heavy melting steel, east'n Pa.	11.25	11.25	11.00	10.75
Heavy melting steel, Chgo.....	9.50	9.25	9.89	9.75
No. 1 wrought eastern Pa.....	12.50	12.50	12.50	12.50
No. 1 wrought, Chgo.....	8.75	8.75	9.00	8.88
Rerolling rails, Chgo.....	10.00	10.00	11.25	11.25
Car wheels, Chgo.....	10.00	9.75	11.75	11.25

(For Additional Prices See Page 1344.)

Foreigners Buy Bessemer Pig Iron

Valley Interest Sells 1,000 Tons for Shipment to Italy and Further Orders Will Probably be Entered—Little Buying Throughout the Country

Pittsburgh, June 22.—A valley interest has sold 1,000 tons of bessemer pig iron for shipment to Italy at a price slightly above the domestic market, and it is probable additional tonnages for similar shipment will be sold before the end of the week. Italian interests have purchased approximately 20,000 tons of bessemer pig iron from Valley makers this year, although all the iron involved has not yet been shipped. The Colonial Steel Co., which entered the market 10 days ago for 10,000 tons of basic for last half shipment, has not yet closed. An indefinite inquiry for 5,000 tons for an interest in the immediate district also is pending. A car wheel manufacturer has purchased from 5,000 to 6,000 tons of miscellaneous foundry grades for last half shipment, and several heavy tonnages of No. 2 foundry have been sold at a range from $12.50 to $13, valley. The Pittsburgh Steel Co., which blew in its second stack June 15, has been quietly offering basic pig iron in the open market. Dealers express confidence that more attractive prices for steel-making and foundry grades soon will be enjoyed.

Considering Future Needs

New York, June 22.—Some consumers of iron in this territory continue to give noticeably greater attention to forward requirements, but there is no general buying movement and the tonnage coming out is not important. Pending inquiries total about 10,000 to 12,000 tons. Indications are increasing that not a few buyers underestimated their needs or acted too conservatively when originally closing some months ago, and they now are being forced to place further orders for filling out their needs during the next few months. In one or two cases, consumers have inquired for delivery after Jan. 1, one case in point being a lot of 1,000 tons for first half. Where the makers have been willing to make prices for such delivery, they have quoted advances of $1 to $1.50 over present figures. A Paterson, N. J., buyer still negotiates for 2,000 tons of foundry; a Connecticut shop for 2,000 to 3,000 tons of malleable; another buyer for 2,000 tons, and there are a number of miscellaneous lots. Sales of the week have been light, but a little better. One up-state buyer took 2,500 to 3,000 tons of malleable, which went to a Buffalo maker. Prices record no improvement in this district and the tidewater range is $14.25 to $14.50 for No. 2X. Central Pennsylvania makers have been making some effort for business here and have quoted down to $12.50, furnace, for No. 2X, or slightly under $14.50, tidewater. Export inquiries were more numerous this week. Italy has purchased another fair-sized block of iron, and there is further inquiry for that country. Servia asks 500 tons of foundry and there is some South American tonnage. Freight rates now are around 50s to Italy and 35 to 30s to the British Isles.

Shipments Best Feature

Philadelphia, June 21.—Shipments of iron to consumers against contracts hold up well and this affords the best feature of the market in this district. New buying is limited and of only fair proportions. Prices in steel making grades are well maintained and seem firm on a higher level, but the foundry situation still shows evidence of irregularity and some producers remain rather aggressive for orders at low figures despite the inclination of various eastern Pennsylvania makers to advance their quotations. A new sale of basic quietly negotiated recently and referred to a week ago, proves to have been made to a Trenton consumer and the amount is understood to have been about 10,000 tons. A nearby furnace will supply the iron. Basic continues at $13.75 to $14, delivered. Sales of low phosphorus during some weeks past

(*For complete prices see page* 1344.)

now leave Lebanon district makers with a large tonnage on their books. Further transactions in standard low phosphorus reached several hundred tons in the week and were done mainly on outstanding quotations of $20.50, Philadelphia. The price now is held at $21, Philadelphia. One easternn Pennsylvania manufacturer of special steel bars recently closed for a good tonnage of this grade. There is considerable divergence in foundry prices, with the market at $14.25 to $14.50, Philadelphia, for No. 2X, and some eastern Pennsylvania makers quoting higher. In central Pennsylvania, down to $12.50, furnace, which is equivalent to slightly less than $14.25, Philadelphia, on No. 2X, for some producers there, has been named. The Baldwin Locomotive Works is inquiring for 1,000 to 2,000 tons of 2.50c to 2.75c silicon and for 500 to 1,000 tons 1.15 to 1.50 silicon iron for delivery over the next three or four months. A Philadelphia machinery builder is figuring on 2,000 to 3,000 tons of northern and southern and claims to have received a quotation of less than $9.50, Birmingham, on a certain brand. At $9.50, Birmingham, the Philadelphia delivered equivalent for No. 2X is $14.03. Another Philadelphia shop bought 500 tons of northern. One of the Crane furnaces at Catasauqua has resumed.

Inquiry for Next Year

Cleveland, June 22.—There is some little inquiry for foundry grades for delivery during the first half of next year, but furnaces are not disposed to quote for that delivery and sales for delivery during the last half of this year are light. Shipments on contracts continue satisfactory.

Inquiry from Michigan.

Cincinnati, June 21. — An inquiry for 1,000 tons of coke malleable, and another for 500 tons of charcoal iron, are out from Michigan territory. The Laidlaw-Dunn-Gordon Co., this city, and the Louisville and Nashville railroad, are asking for a few car loads each. These constitute the inquiries before the market here. The situation is exceedingly quiet and void of new transactions. Shipments on old contracts are heavy, and are the brightest spots in the market. Prices show no tendency to vary. Southern No. 2 foundry is quoted at from $9.50 to $10, Birmingham basis, and southern Ohio No. 2 foundry at from $12.50 to $12.75 Ironton basis, both for last half shipment.

Small Buying is Rule

Chicago, June 22.—Although no decided activity is manifest in the pig iron market, there is considerable buying in the aggregate. Principal interest attaches to the malleable situation, which is much improved over conditions existing for a number of months past. Numerous malleable foundries have increased activity following buying of railroad cars and they are actively seeking to cover their requirements for pig iron. However, this movement is not sufficiently general to constitute an important factor and apparently melters are simply covering for their needs as expressed in contracts already taken.

As a general proposition, inquiry is light and sales are for small tonnages and usually for some special analysis to be used in bringing the foundry mixture to the proper condition.

One important producing interest has not bid on business nor sold any tonnages for more than a week and in the meantime is readjusting its order book to the conditions of production at its plant. The fact that premiums for high silicon have been insisted on has resulted in some accumulation of this grade which is now being disposed of more readily than before it was made evident to melters that silicon must be paid for.

Two inquiries for about 2,000 tons each of malleable are before the trade and a third for about 1,200 tons is also being considered. A railway equipment concern with several plants is about to enter the market to cover its requirements for second half, which will be fairly large.

No change has taken place in the situation as to price and $13, Chicago furnace, continues, with added premiums for high silicon or other costly special constituents.

Southern iron is dull, with most sellers holding for $10, Birmingham, but the possibility exists of obtaining tonnages at 25 to 50 cents per ton lower.

Some demand is being experienced for charcoal iron, which has been holding steadily for a long time.

Inquiry Increases

Buffalo, June 22.—During the week, inquiry for 20,000 to 25,000 tons of pig iron has come into the market at Buffalo for foundry grades and some malleable for delivery over third quarter and last half of the year. The total sales for the week have been light and the noted inquiry is still seeking placement. The inquiry for 3,000 tons of malleable reported a week ago has been placed with a local producer and several other sizable malleable orders are now being figured.

The price situation has not changed except in tone. The range of $12.50 to $13.25 covering all grades with slight regard for differentials is more firmly held and may stiffen within a short time. Heavy shipments of iron under contract continue from the furnaces of the district.

(*For complete prices see page* 1344.)

Inquiry for Basic

St. Louis, June 21.—Prospects for better business in pig iron have improved by the appearance in this market of an inquiry for 4,000 to 5,000 tons of basic, and local sales agents who have received the inquiry are keen to capture the sale. Inquiries also are out for 500 tons of southern No. 2 and 100 tons of northern iron. Sales last week were confined to a few car loads. Southern iron is generally held at $10, Birmingham basis, and northern at $13.50 to $14, Chicago, and $13 to $13.50, Ironton.

Very Quiet

Birmingham, Ala., June 22.—Pig iron is very quiet, the market being without any developments. Only small orders are being received and inquiry is reported light. No. 2 foundry is being sold for immediate delivery at $9.75 and for last half delivery at $10. Makers say they contemplate no weakening in prices.

Steel Casting Company Expanding

The George H. Smith Steel Casting Co., Milwaukee, Wis., has purchased the property on which its foundry has been located for the past 17 years, also buildings and land adjoining. The company plans to erect shortly a new building 65 x 150 feet to serve as a shipping room, which will enable it to use its main foundry exclusively for molding and casting, and it is expected to largely increase the capacity.

This company has been manufacturing with the converter process about 16 years, having erected and operated one of the first commercial converter foundries in the United States.

It is the original maker of "Dynamo" or low carbon steel castings for electrical purposes in this country, and also makes alloy steels of various kinds including manganese, vanadium, nickel, chrome, also castings of special carbon.

The North works of the Carnegie Steel Co., at Sharon, Pa., will resume operations just as soon as a few necessary repairs can be made. The plant has been idle 18 months. The Carnegie Steel Co. is operating 44 of its 59 blast furnace stacks.

Bars for Domestic Use

Are in Active Demand and Specifications Liberal—Market Generally Firm, But Cutting is Done on Deformed Bars

New York, June 22.—So much emphasis has been laid upon the large orders for bars for ammunition shells for export, that the regular lines of domestic trade in this product have been somewhat obscured. It is to be noted now, however, that domestic users are experiencing an enlargement of demand and they are specifying generally for heavier tonnages. Some of this larger movement, perhaps, is in response to a note of warning sounded by the mills that in view of the influx of large orders for shell rounds, they cannot be so certain of future deliveries. Some of the leading mills have urged the trade to get in their specifications as soon as possible, and this suggestion has had its effect. It is understood that some of the companies which have bought large tonnages of rounds for future delivery are filing specifications ahead to insure shipments. The market still shows many inquiries for bars for ammunition and some sales. A New Jersey electric company in the week placed 2,600 tons of 3½-inch high explosive bars. A Jersey City iron works is inquiring for 1,200 tons. One cabled inquiry called for 5,000 tons a month for the remainder of the year. One lot of 20,000 tons still is talked about. Some mills are more independent in selling rounds and are holding those of shell size at from 1.90c to 2.15c at the mill. Some of the business of this kind recently taken in this territory, however, has been much below these figures. The Republic Iron & Steel Co. has followed other makers in advancing bars to 1.25c, Pittsburgh, but at least two large makers still are quoting 1.20c. Some third quarter contracts are reported at 1.25c, Pittsburgh, or 1.419c, New York. A Hudson river buyer contracted for 500 to 700 tons.

1.20c Still Outstanding

Philadelphia, June 21.—Prompt steel bars at least still may be had at 1.20c Pittsburgh, or 1.359c, Philadelphia, from certain mills and the indications are larger buyers could extend this figure through the third quarter. It is not believed, however, that this condition will prevail long, as the two or three important producers who have not yet advanced to 1.25c, Pittsburgh, are expected to do so before July 1. The Republic Iron & Steel Co., effective today, advanced its price to 1.25c, Pittsburgh, for either prompt or third quarter. A number of the larger buyers in this territory closed contracts with the respective mills at 1.20c, Pittsburgh, before the $1 advance, but many of the smaller trade were booked at 1.25c, Pittsburgh. Some negotiations by larger buyers, who are seeking 1.20c, Pittsburgh, for last half, continue. Specifications against expiring second quarter contracts, most of which were at 1.15c, Pittsburgh, continue active. About 225 tons of rivet rods will be required for the new collier CUYAMA for which the government now is asking the steel. Leading makers of cold rolled shafting effective July 18 advanced two points, or $2 a ton to 68 off for carloads and 63 off for less carloads.

Steel Bars Sell at 1.25c

Pittsburgh, June 22.—Demand for steel bars for the manufacture of war material continues heavy. Although no official announcement has been made, it is understood one of the larger manufacturers in this district recently has booked several attractive orders for the manufacture of shells. Steel bars are being held at 1.25c by several manufacturers and some material already has been sold at that figure. Iron bars are commanding 1.25c and talk is heard of that figure being withdrawn.

Contracting More Freely

Buffalo, June 22.—Mills and agencies of the Buffalo district report bars to be one of the leaders in the contracts now being closed by consumers for material to take the place of contracts expiring with the present quarter. Some of the users in placing orders for their needs for third quarter and in some cases for last half are contracting for larger tonnages than were ordered to meet their requirements for the current and first quarter of the year.

There is an effort being made on the part of a number of the mills to curtail speculative buying by limiting the tonnages contracted for to actual requirements based on past records of the consumers.

Steel Bars Active

Chicago, June 22.—With practically all agricultural implement makers now covered for their requirements over last half and other consumers of steel bars taking considerable tonnages, this market is assuming a most active aspect. Prices have been advanced generally to 1.44c, Chicago mill, although one important independent interest has not followed the lead and is still willing to take business at 1.39c, Chicago mill. How long this condition will remain depends entirely on its mill book, and as soon as tonnage appears it probably will follow other independents which have advanced to 1.44c.

Increased demand by railroads for almost every form of equipment is reflected in the bar market and this is more active than has been the case for many months.

Rerolled hard steel bars are being contracted in considerable volume and quotations remain steady at 1.20c to 1.25c, Chicago.

Bar Iron Quiet

Chicago, June 22.—Bar iron mills continue to operate approximately at 50 per cent capacity and no essential change in the situation has appeared. Some small tonnages are coming out, but nothing of importance and the market is marking time with quotations steady at 1.20c, Chicago mill.

Reinforcing Bars Weak

Cleveland, June 22.—Steel bars are very strong and the leading interest is so well supplied with orders that it will not promise deliveries short of several months. The only weak feature of the situation is in deformed reinforcing steel bars, of which sales have been made at 1.15c, Pittsburgh. Low quotations on these bars are attributed in part, at least, to the competition of rerolled material. The bar iron market is dead and the Empire and Union mills are rolling steel bars.

Hoops, Bands and Shafting

Pittsburgh, June 22.—The Columbia Steel & Shafting Co. has advanced quotations for cold rolled shafting $2 a ton and is now quoting this product at 66 per cent off for prompt and future delivery. The Columbia company has been enjoying fairly heavy demand for its products, and, like other shafting interests, is operating at practically maximum capacity. Shafting continues to be offered for immediate delivery at 68 per cent off and even that figure has been shaded within the last fortnight, but the market is much stronger than it has been for many months. Steel bands are being quoted at 1.25c and steel hoops are held at 1.30c, although the 1.25c quotation for hoops has not entirely disappeared.

The Boston office of the Sullivan Machinery Co., Chicago, has been removed from 35 Federal street, to the Unity building, 185 Devonshire street.

(*For complete prices see page* 1344.)

More Orders for Ships

And the Schwab Fleet Will Probably be Built in This Country—Still More Irregularity in Plate Prices

New York, June 22.—The Bethlehem Steel Co., which some time before the war arranged through foreign shipping interests for a fleet of five 17,000-ton vessels to be built in British yards, now is expected to have these vessels constructed in this country because of the filled-up capacity on war work of the plants abroad. These vessels are intended to carry iron ore from the Bethlehem company's mines in Chile. It is learned the company already has made tentative inquiries, looking toward the arrangement of such a ship building contract. There is no pause in the unprecedented activity in the eastern ship building market. New awards of the week include two vessels, another for the Munson line, to the Newport News Ship Building & Dry Dock Co., making four in all closed by that line, and a second ship for the Luckenbach Steamship Co., understood to have been taken by the Fore River Ship Building Co. This increases the total eastern awards to 39. Another Atlantic yard is on the verge of closing contracts for one or two additional vessels. The Standard Oil Co. still is in the market for another bulk tanker and English shipping interests have inquired of eastern yards for three 5,000 to 6,000-ton merchant boats. The two vessels just awarded will require 2,500 to 3,000 tons of steel each, largely plates, which will be divided between Pittsburgh and eastern mills. Plate prices in this territory show some spread at present and are quoted openly from 1.20c to 1.25c, Pittsburgh, or 1.369c to 1.419c, New York. Larger buyers recently have done lower than the minimum figure on contract. One large contract recently renewed for last half with an eastern mill is understood to have been done considerably below 1.20c, Pittsburgh.

Plate Tonnage Spotty

Philadelphia, June 21.—Orders for universal plates with eastern Pennsylvania mills are limited, but in tank, boiler and special qualities the tonnage is good and appears on the increase. One maker has extended its activities to 90 per cent of total capacity, due mainly to tank and boiler steel tonnage. Other mills have been doing better, but one producer not so well established in this line is running only about half capacity this week. A large tonnage of plates for new vessel construction placed with Atlantic coast yards continues to come out. Two or three additional boats were closed with these builders in the week. The government is asking 2,250 tons of plates, bids to close July 6, for the collier CUYAMA, which will be built at a Pacific coast navy yard. A small tonnage also is wanted for a ferry boat for the Charleston navy yard. The Standard Oil Co. of New Jersey has extended through the last half a contract with an eastern Pennsylvania mill the maximum requirements of which are placed at 10,000 tons. Prices on plates with eastern makers still show a considerable range. Quotations below 1.20c, Pittsburgh, are gradually being withdrawn and the market appears to be hardening at the latter figure as a minimum. Some eastern makers have advanced to 1.25c for third quarter and have taken a number of contracts on that basis.

Plates Quoted at 1.25c

Pittsburgh, June 22.—More important plate manufacturers are quoting this product at 1.25c for prompt and third quarter delivery. The 1.20c figure for immediate shipment has not entirely disappeared, and 1.15c continues to be reported in isolated cases. Heavy buying of steel cars the last few weeks by domestic and foreign railroads has materially benefited the market for structural material. Despite irregularity, sellers express the belief that the 1.25c figure will be firmly established within the next few weeks.

Plates Still Lag

Chicago, June 22.—Although demand for steel plates has increased considerably, following larger orders for cars and in the east for ship building, they may be obtained on an open quotation of 1.34c, Chicago mill, from at least one maker. Other sellers are quoting as high as 1.44c, Chicago mill, and claim to be signing business at that level.

Wire is Active

Pittsburgh, June 22.—Domestic and foreign demand for wire products continues heavy. Specifications are coming out in good volume from all parts of this country and foreign interests are playing a conspicuous part in the market. Some mills are unable to promise material for anything like prompt shipment. Wire nails are being held at $1.60 a keg, by several prominent mills, but the $1.55 quotation is being offered in some instances. Extras for galvanizing are being maintained in all instances.

(For complete prices see page 1344.)

Bolt Makers

Report Decided Improvement—Rivet Prices Not Tested

Cleveland, June 22.—Everybody is covered by rivet contracts up to July 1. No contracting is reported beyond that period and hence the recent advance in quotations has not been tested. Cleveland bolt manufacturers are enthusiastic in their reports concerning improvement in business. The recent advance is being maintained and demand is much more active.

Nuts, Bolts and Rivets

Pittsburgh, June 22.—Fairly heavy demand is reported for nuts, bolts and rivets, and most plants in the Greater Pittsburgh district are operating at maximum capacity. Structural rivets are being quoted at 1.50c for third and 1.60c for fourth quarter delivery, and boiler rivets are quoted at $2 a ton above those figures. Prevailing discounts for nuts and bolts are firmly maintained. Talk of advances in quotations for nuts and bolts is heard.

More Inquiry

Buffalo, June 22.—Agencies here report a noticeable increase in the inquiry for bolts and nuts for delivery over the third and fourth quarters of the year.

Improvement

In Warehouse Business Continues a Favorable Feature

Cleveland, June 22.—One of the most encouraging features of the general situation today is the continued improvement in warehouse business. This is marked in the Cleveland district. As very little, if any, of this business can be traced to war orders, it indicates a healthy development of domestic trade.

Warehouses Are Busy

Chicago, June 22.—Chicago warehouses continue to sell galvanized sheets No. 28 gage at 5.85c, although in a few instances where stocks are unusually low, 5.00c is being asked. Assortments remain full and those who can use sheets at this price are finding no difficulty in filling their requirements while mills are not quoting. In other lines, warehouse business continues active, except for the diminution of demand caused by labor troubles in this city.

Sheet Mills Are Busy

In Spite of Reduction in Galvanized Product—Some Low Prices on Blue Annealed

Pittsburgh, June 22.—Manufacturers of steel sheets in western Pennsylvania and eastern Ohio are enjoying fairly heavy demand, although galvanizing departments, in many instances, have been closed down on account of the almost prohibitive price of spelter. Despite contrary reports, no changes have been made in the differentials for the several gages of galvanized sheets. Most independent concerns are quoting No. 28 gage galvanized sheets at 5.50c and above, but all quotations are considered nominal. Automobile concerns are actively covering needs for the last half and specifications against contracts from automobile builders are heavy. No. 28 gage black sheets are listed at 1.80c, Pittsburgh.

Getting Advances in East

Philadelphia, June 21.—A number of buyers of sheets are placing forward contracts with eastern Pennsylvania makers at this time and advances of $1 to $2 a ton over current orders are being insisted upon by the mills. For third quarter 1.35c, Pittsburgh, and for fourth 1.40c, Pittsburgh, for No. 10 gage blue annealed are quoted. At Philadelphia 1.509c and 1.559c, respectively, are being quoted and obtained. Specifications at present are active and leading makers in eastern Pennsylvania are operating to capacity. After some recent irregularity in rates, the standard charge by the steamship companies on the haul to the Pacific coast through the Panama canal has been established on sheets at 45 cents per 100 pounds.

Galvanized Sheet Easier

Cleveland, June 22.—The galvanized sheet market is a shade easier on account of the decline of spelter, but only those who are compelled to use galvanized sheets are buying at this time. Although some mills are well supplied with orders for black and blue annealed, prices continue to be irregular and some very low quotations are being made on blue annealed in highly competitive territory.

Galvanized Sheets Lower

Cincinnati, June 21. — Galvanized sheets are quoted a little below last week's prices because of a slight decline in the spelter market. They are given today at from 5c to 5.50c, Pittsburgh basis, for No. 28 gage. Black sheets No. 28 gage are unchanged at 1.80c, Pittsburgh basis. Sales are low because of the uncertainty of prices and the fact that mills will sell certain grades for prompt delivery only. Rolling mills in this territory are running full in all departments.

No Galvanized Yet

Chicago, June 22.—Although spelter has declined sharply and galvanizing concerns have been offered tonnages under 20 cents, the price still is too high for it to be utilized in the manufacture of galvanized sheets and makers still refrain from quoting. Indications are that considerable litigation will result from the spelter situation as reflected in galvanized sheets, and it is understood some suits have been started for damages caused by breaking of contracts.

Black sheets remain soft and demand is not sufficient to care for the mill capacity available.

Tin Plate Stronger

Pittsburgh, June 22.—Manufacturers of tin plate in the Greater Pittsburgh district say prices have stiffened moderately the last 10 days. Specifications are fairly heavy and inquiries for export involve rather large tonnages. Tin plate continues to be listed at a spread from $3.10 to $3.20, base.

Coke Stiffens

Pittsburgh Steel Co. Closes for 20,000 Tons for Last Half

Pittsburgh, June 22.—The Pittsburgh Steel Co. is understood to have closed negotiations for about 20,000 tons of blast furnace coke for last half shipment, but details of the purchase are not known. Demand for third and fourth quarter blast furnace coke is rather heavy and prices appear stronger than previously. Several important sellers are refusing to quote for last quarter delivery, except at prices considerably above those prevailing for third quarter shipment. Spot furnace and foundry coke continue to be offered at rather low figures. The *Connellsville Courier*, for the week ending June 12, says production was 334,514, compared with 314,897 for the week before.

Buys Under Market

Philadelphia, June 21.—A Reading furnace has purchased 12,000 tons of furnace coke monthly for last half delivery and was able to shade $1.75, ovens, which appears to be the usual price for standard Connellsville 48-hour coke. There is some question, according to market talk, whether the fuel involved is of strictly standard quality. An eastern Pennsylvania steel company has exercised an option to extend a first half contract through the second half.

Sales are Lighter

Cincinnati, June 22.—Sales of foundry coke are not as heavy as they were a week ago, but this is because almost all foundries in this territory have closed for next year's requirements, beginning July 1. There is no demand for furnace coke, as all furnaces in blast are well supplied for several months. Shipments on both 48 and 72-hour grades are very good. Wise county foundry coke is quoted at from $2.25 to $2.50, ovens, Pocahontas foundry coke at from $2 to $2.25, ovens, and New River foundry coke at from $2.50 to $3.

Lead Company Buys

St. Louis, June 21.—One of the largest lead companies in the middle west has closed a contract for 36,000 tons of furnace coke for shipment over the year, beginning July 1. An inquiry for 1,000 tons of foundry coke also is in the market, and several car load inquiries for prompt shipment.

Galvanized Pipe Boosted

Pittsburgh, June 22.—Under date of June 17, steel and iron pipe manufacturers advanced quotations for galvanized material $12 a ton. Galvanized steel pipe has been boosted $30 a ton this year, due to the high price of spelter. Iron pipe manufacturers have closely followed the market for steel pipe. Under date of June 15, steel and iron boiler tubemakers advanced quotations $2 a ton. It is understood that orders for 60 miles of 8-inch and 10-inch, 50 miles of 6-inch and two miles of 18-inch steel line pipe, involving a total of 6,500 tons, have been distributed among mills in this district within the last 10 days. Iron and steel pipe mills are operating at about 75 per cent of rated capacities.

Governor Brumbaugh, of Pennsylvania, has vetoed a full crew law repealer, contending that the law enforcing railroads to provide extra crew men is a safeguard to life and property. Railroad companies assert that the services of the "extra" men are not needed.

(*For complete prices see page* 1344.)

Look for Greater Activity

In Structural Material—A Leading Company Bids 1.30c on Steel for Municipal Bridge at St. Louis

New York, June 22.—Structural steel companies are looking forward to greater activity in their line at a later date as result of the better tone that has been displayed by the iron and steel market generally during the past several weeks. At the moment, however, there are no signs of appreciable betterment in the structural situation. New lettings in this territory remain of rather mediocre extent and there is an absence of projects calling for round tonnages. The architects report they are working on a better volume of business, but this seems to be largely future business. Leading fabricating shops in this and surrounding territory are active at present not to exceed 60 to 70 per cent, and that they are able to maintain this rate is due to small work, chiefly, which holds up fairly well. A strike of the inside iron workers in the metropolitan district, now in progress, is not expected to have much effect upon the situation, as it involves only smaller shops. Even should the trouble spread to other classes of structural workers, it will not interfere with most of the larger plants, which are open shops. Plain material prices at present appear to be in a transient stage, looking to the establishment of a 1.25c contract market. At present, however, 1.20c, Pittsburgh, or 1.359c, New York, still is being quoted by some mills, and it is believed the larger buyers would have no difficulty in getting a contract at this figure, at least before July 1.

Higher Quotations

Cleveland, June 22.—One steel company has quoted 1.30c, Pittsburgh, on the 24,000 tons for the municipal bridge at St. Louis. This quotation is accepted as positive evidence of the increased strength of the structural market, although the deliveries extend far into next year. On an inquiry for 10,000 tons for the Polk street bridge for the Pennsylvania railroad, Chicago, 1.25c, Pittsburgh, has been quoted. The principal contract awarded in northern Ohio during the past week was for 2,500 tons for an office building at Toledo, O., for the Willys-Overland Co., taken by the Donovan Wire & Iron Co., Toledo. The steel is largely Bethlehem sections, but some Jones & Laughlin standard sections will be used. T. H. Brooks & Co. have taken 400 tons for the new Cleveland foundry of the Westinghouse Electric & Mfg. Co. The Massillon Bridge & Structural Co., Massillon, O., has been awarded 500 tons for the Model market building, Forty-sixth street and Euclid avenue, Cleveland.

Not Increasing Operations

Philadelphia, June 21. — Eastern Pennsylvania shape mills are getting in a fair tonnage and are running around 70 to 75 per cent on accumulated business, but apparently there is not much immediate prospect of their increasing their activities from new orders which are relatively light. Two or three of the eastern mills have adopted the 1.25c, Pittsburgh, or 1.409c, Philadelphia, price for third quarter, but had booked some contracts at 1.20c, Pittsburgh, before advancing. They still will do 1.20c for early specification, and the outlook is certain mills will accept this figure for third quarter for a time at least. Some low priced contracts, 1.10c and 1.15c, Pittsburgh, will expire July 1, and in at least one case such a booking was extended through July to include an additional tonnage. About 1,200 tons of shapes are in the market for a new government collier. A 1,000-ton office building addition in this city is up. The Pennsylvania Steel Co. has its new 28-inch structural mill at Steelton in readiness for operation. This mill will place this company in an independent position on shapes, as it previously bought some tonnage, and will enable it to offer some quantity in the market, which it already has done.

Prices Stiffen

Buffalo, June 2.—Structural lines seem to be in the lead of the finished materials which reflect a marked improvement in the market. With the exception of a single producing interest prices have stiffened to 1.25c, base, for spot shipments and third quarter and 1.30c for last quarter. The single interest for the present is quoting 1.20c on spot and 1.25c for last half, but may join the other companies at any time in quoting the advanced schedules on all lines.

Shapes Bringing 1.25c

Pittsburgh, June 22. — Structural shapes are being quoted at 1.25c by more important makers in the Greater Pittsburgh district, and it generally is believed the 1.20c figure will disappear before the end of the month. Fabricating shops are in need of additional tonnages, which accounts for some of the low quotations recently reported. Plate and shape mills are being driven at practically maximum capacity.

(*For complete prices see page* 1344.)

Shapes Are More Active

Chicago, June 22.—Added activity is being manifested in demand for structural shapes and contracts for plates in the west during the past week amount to practically 3,000 tons.

The largest item is 1,150 tons for the Monroe street bridge in Chicago, a part of the west side railway terminal improvements now under way. This tonnage was taken by the Chicago Bridge & Iron Co.

Structural shapes have been advanced to 1.44c, Chicago mill, and shops are filling up rapidly as increased demand is experienced. Specifications are being received promptly and if business continues at the present rate, deferred delivery will be the rule shortly.

CONTRACTS AWARDED.

Monroe street bridge, Chicago, 1,150 tons, to Chicago Bridge & Iron Co.

Chicago, Milwaukee & St. Paul Ry. Co., five 105-foot spans, 585 tons, to Federal Bridge Co.

First National Bank building, Portland, Ore., 340 tons, to Northwest Steel Co.

American Car & Foundry Co., yard crane runway and car shop addition, Chicago, 322 tons, to American Bridge Co.

Wisconsin Zinc Co., roasting and separating plant, Champion, Wis., 318 tons, to Kenwood Bridge Co.

Machinery for Monroe street bridge, Chicago, 155 tons, to Allis-Chalmers Mfg. Co.

Pierce Arrow Motor Car Co., Buffalo, factory addition, 400 x 60 feet, 4 stories, 300 tons reinforcing bars, general contract to Aberthaw Construction Co., Boston.

New buildings for Aluminum Co. of America at Edgewater, N. Y., 1,000 tons, to McClintic-Marshall Co.

Additional extensions to the plant of the Scoville Mfg. Co., Waterbury, Conn., 1,000 tons, to Levering & Gerrigues.

Sub-stations for Manchester, N. H., traction company, 200 tons, to Levering & Gerrigues.

First National Bank building, Scranton, Pa., 175 tons, to Phoenix Iron Works.

Building for the Philadelphia Life Insurance Co., Philadelphia, 180 tons, for the American Bridge Co.

Addition to the Bulletin building, Philadelpha, 1,000 tons, general contract placed with Doyle & Co., Philadelphia.

Section No. 1 of the Nostrand avenue subway, Brooklyn, 6,400 tons, general contract awarded the Newman & Carey Co.

Building for Grand Union Tea Co., Brooklyn, 800 tons, to the American Bridge Co.

Building for the Loomis Institute, Windsor, Conn., 300 tons, to Hedden Iron Construction Co.

Building for Experimental Station of the Bureau of Mines, Pittsburgh, 450 tons, to the American Bridge Co.

Building for R. D. Stevens Milk Co., Third and Dean streets, Brooklyn, 400 to 500 tons to Communipaw Steel Co.

Remaining bridge work for the Pennsylvania

railroad, 1,000 tons or more, distributed among various fabricators.

Office building for the Willys-Overland Co., Toledo, O., 2,500 tons, to the Donovan Wire & Iron Co., Toledo.

Foundry at Cleveland for the Westinghouse Electric & Mfg. Co., 400 tons, to T. H. Brooks & Co., Cleveland.

Market building, Cleveland, 500 tons, to the Massillon Bridge & Structural Co., Massillon, O.

CONTRACTS PENDING.

Extensions to plant of McKeesport Tin Plate Co., McKeesport, Pa., 2,000 tons.

Extensions to plant of Standard Tin Plate Co., Cannonsburg, Pa., 2,000 tons.

Jacob Dold Packing Co., Buffalo, plant addition, reinforced concrete, taking 200 tons reinforcing bars, will take bids soon.

Gurney Ball Bearing Co., Jamestown, N. Y., plant addition, 350 tons structural, open bids by June 26.

Bridge for New York Central railroad over barge canal, Syracuse, N. Y., 250 tons, bids being taken.

Sub-structure for municipal pier at Twenty-ninth street, Brooklyn, 300 tons, Henry Steer, Inc., low bidder, on similar structure of like tonnage, Thirtieth street, Brooklyn, W. P. Seaver & Co., low bidder.

Breaker for Lehigh Valley Coal Co., Wilkesbarre, Pa., 200 to 300 tons, bids being taken.

Hotel and theater building, Charleston, S. C., 1,000 to 1,500 tons, bids being taken.

Store and loft building, 626 Fifth avenue, New York City, 350 tons, bids being taken.

Grandstand for the Wequahic club, Newark, N. J., Chas. Goeller Construction Co., low bidder. No award yet made.

Center arches for Pennsylvania railroad bridge at Manyunk, Pa., about 500 tons, bids being taken.

Scrap Market

Is More Active in Eastern Pennsylvania—Dull in Most Centers

Philadelphia, June 21.—One leading eastern Pennsylvania consumer has closed for 2,000 to 3,000 tons in several lots of No. 1 heavy melting steel at $11.25, delivered. As previously noted, another eastern Pennsylvania buyer has taken 1,500 tons or more of this grade within a week or ten days at $11.50, delivered, so that the latter figure apparently represents the top of the market. Some other buyers still offer only $11, delivered. These sales of steel scrap, while comparatively small, are larger than recently done and they illustrate the fact that the general scrap market here is more active in a limited way. There has been more buying of heavy cast by the larger foundries, usually in 200 to 500 ton lots at $12 to $12.50, delivered, but one large Philadelphia consumer bought 1,000 tons. Low phosphorus is strong and rather scarce. Car wheels are in small demand. Offers of $9.50, delivered, are available for borings and turnings. The British Isles have out new inquiries for car wheels and are prospective buyers of heavy melting steel.

Trading Light

New York, June 22.—A better tone which has been noted recently in the old material market, has not yet been reflected in prices. Trading remains comparatively light, due to the fact that consumers will not freely pay the prices which the dealers and brokers are asking. One eastern Pennsylvania mill, which entered the market for heavy melting steel at $11.25, delivered, found this price unacceptable to some sellers in this district. It bought some tonnage at this figure, however. A Lebanon, Pa., company which is about to start a new open hearth plant is inquiring for steel scrap and is expected to require about 2,000 tons monthly. There is some movement in cast scrap in quantities of 500 tons and less. Heavy cast is bringing from $11.50 to $11.75, delivered Jersey points, with special quality at $12, delivered, and machinery cast at $12.50 to $13, delivered to Jersey consumers. Borings and turnings are in some demand.

Near Stagnation

Pittsburgh, June 22.—Despite increased activity enjoyed by manufacturers of finished iron and steel produces, scrap dealers in the Greater Pittsburgh district say the market borders on stagnation. Several heavy consumers have directed dealers to discontinue shipments until further notice. Heavy stocks are being carried by most mills. Heavy melting steel is held at $11.75 and above, but quotations have not been severely tested this month.

Market More Active

Buffalo, June 22.—The Buffalo scrap market shows a noticeable increase in activity in the past week, particularly in heavy melting steel and railroad malleable scrap. Several fairly large tonnages of the latter have been placed at $10.75.

The dealers of the district report that the market has become stronger within the past two weeks. Railroad malleable is strong at the advanced price reported a week ago. If the demand continues for this and other lines, a further advance may be expected. Shipments are moving forward freely in borings, turnings, bushheling scrap, Nos. 1 and 2 and in bundled sheet scrap. Prices of the various lines remain unchanged.

Market Sleeping

Chicago, June 21.—Absolute quiet pervades the iron and steel scrap market in Chicago, practically no trading is being done and consumers are not in the market except for an occasional bargain. Dealers seem contented to let matters drift and are not seeking to push sales. Quotations remain steady; in fact, not enough tonnage is changing hands to indicate actual levels.

Railroads continue to offer considerable tonnages, the following lists being active at present: Chicago & Alton, 600 tons; C., M. & St. P. railway, 2,200 tons, including 500 tons of No. 1 wrought and 500 tons of long steel rails; Rock Island, 2,300 tons, including 400 tons of No. 1 wrought; Great Northern, 1,300 tons, including 550 tons of long steel rails.

Market Low

Cincinnati, June 22.—Efforts of dealers to revive business in the scrap market are futile. Transactions are at the minimum, and better conditions are not in sight. Shipments to rolling mills on old contracts are good, but jobbing foundries are taking requirements very sparingly. No changes in prices are reported, and none are expected in the near future.

Advance at St. Louis

St. Louis, June 22.—The scrap market manifested a firmer tone throughout last week, and prices have advanced from 25 cents to 50 cents a ton on nearly all grades. Railroad offerings on the market for next week are: Great Northern, 1,500 tons; Lake Erie & Western, 600 tons; Chicago & Alton, 300 tons.

Prices Weak

Birmingham, Ala., June 22.—Scrap iron is very inactive and dealers state that there seems little chance of improvement. Prices are weakening, as there is very little demand for scrap at any price.

(*For complete prices see page* 1344.)

Building New Mill

The Ohio Seamless Tube Co., Shelby, O., has started the erection of a new plant, designated and to be equipped especially with machinery for the producing of seamless tubes from high carbon high chrome steel for ball and roller bearings and other special purposes; also for the manufacture of a full line of seamless tubes from various alloy steels for special purposes. The estimated cost of the plant and equipment is $350,000 to $400,000.

The Ohio Seamless Tube Co. specializes in the manufacture of a high grade of seamless tube.

The Allis-Chalmers Mfg. Co., Milwaukee, Wis., which made a 10 per cent reduction in wages and salaries of the office force on March 1, owing to the continued depression in industrial activities, will restore one half of the cut, or 5 per cent, on July 1. About 1,200 employes are affected.

Ford Will Build Furnaces

Steel Plant and Finishing Mills—Says Acquiring of Ore Lands is a Matter for Future Decision

Detroit.—June 22.—Henry Ford, motor car manufacturer, will become a steel producer.

This announcement was made in Detroit during the latter part of last week; in conjunction with it was the announcement that a series of plants, comprising blast furnaces, a steel plant, and finishing mills—these to be used in the process of manufacture of farm tractors—will be constructed on property recently purchased between Oakwood and Dearborn. These plants will be in operation within two or three years. Mr. Ford, however, does not expect that they will reach their maximum efficiency until 1925. When complete they will employ approximately 20,000 men.

Ore Direct to Consumer

Mr. Ford, in a statement given out Saturday, announced:

"Waste will be stopped in the making of steel in Detroit." Great ore boats of the lakes now pass Detroit with their cargoes and travel hundreds of miles further. The ore is converted into steel and then shipped back across hundreds of miles to Detroit. The Rouge plant, so-called, will put an end to this extra hauling.

"Thus far the real plans for the development of the district are only general in character. The details still have to be formulated but they will be taken care of soon. It is my wish to get work under way this year and have the blast furnaces and factories working as soon as possible.

"The farm tractor, which is a machine that has past the experimental stage, will be of many uses. Its first work on the farm will be that of a plow. When the plowing is done, the machine can be converted into a plant puller. It will haul farm materials anywhere; I expect it to supplant the work horse in every way."

Mr. Ford has received assurances that the government will dredge the Rouge river (it is a navigable stream) and will prepare a basin for the turning of great lake boats. It will be possible to make shipments through the Welland canal to European and other ports and his plans for docks, etc., include arrangements for the handling of such shipments.

It is expected that 1,000,000 or 1,500,00 farm tractors will be manufactured during the firm's first real year of work and this means a broadening for the business that is expected in succeeding seasons.

Several of these tractors have been used on the Ford farm near Dearborn for the past year or two and they have been successful. Asked about the possibility of the Ford company owning mines, Mr. Ford said:

"Well, that may come later. That is something for the future to decide. But—it is entirely possible."

There is an impression in Detroit that this new concern of Mr. Ford is one that will have its own lake boats and with the almost unlimited resources now at his command, imagination, alone, supplies the extent of possibilities.

The purchase of the property on which this plant or series of plants, is to be erected was accomplished within 30 days. Real estate agents for the company went into the district, secured options on parcels of property and it is now estimated that he has 2,000 acres under his control.

He will not need all this property, but he thinks that his workmen are entitled to consideration for their homes. Such property as is not needed for the factories will be parceled to the workmen at a price in accordance to the actual cost. This means that Ford employes will not be under the control of real estate agents, as happened in the motor works in Highland Park, and that it will be a city all by itself.

D. R. Hanna Retires From M. A. Hanna & Co.

M. A. Hanna & Co. announces that D. R. Hanna has retired from membership in the firm and that L. C. Hanna and H. M. Hanna Sr. have associated themselves with the remaining partners, R. L. Ireland, M. Andrews and H. M. Hanna Jr. D. R. Hanna's father, the late Senator M. A. Hanna, started business with Hanna, Garretson & Co., wholesale grocers, in 1857 and continued with that firm and its successor, Robert Hanna & Co., until 1867. In that year, when the pioneer iron and coal firm of Rhodes, Card & Co. retired from business, M. A. Hanna became the senior member of the succeeding firm, Rhodes & Co. They were dealers in coal and iron, their coal mines being located in Tuscarawas county, Ohio. The other members of the firm were George H. Warmington and Robert R. Rhodes. The firm was dissolved in 1885 and was succeded by that of M. A. Hanna & Co., the members then being M. A. Hanna, his brother, L. C. Hanna, and A. C. Saunders. D. R. Hanna, was admitted to the firm in 1891, and C. C. Bolton in 1892. Mr. Saunders retired in 1893. Silas Hitchcock was admitted in 1902, and R. L. Ireland in 1904. Mr. Hitchcock and Mr. Bolton retired in 1903. After the death of Senator Hanna, in 1904, the members of the firm were L. C. Hanna, D. R. Hanna, R. L. Ireland and the estate of M. A. Hanna. L. C. Hanna retired at the end of 1904, and the estate in 1905, and M. Andrews was admitted to membership in 1906. In 1912, H. M. Hanna Jr. was admitted to membership and the members were D. R. Hanna, R. L. Ireland, M. Andrews and H. M. Hanna Jr. until the retirement of D. R. Hanna last Saturday. Until that time, H. M. Hanna Sr. had been connected with the firm. The firm of M. A. Hanna & Co. had offices in the Perry-Payne building from 1889 until 1913, when they moved to the Leader-News building.

Pittsburgh Foundrymen Elect

The Pittsburgh Foundrymen's Association held its last meeting of the fiscal year June 21 at the Westmoreland Country club, near Verona, Pa. Members left the Fort Pitt hotel in automobiles and a 3-inning baseball game was played before dinner, which was served at 7 o'clock. A "silver" loving cup was presented H. J. Koch, the retiring president of the organization. Officers for the year were elected as follows: President, George B. Koch, superintendent, Pennsylvania Railroad Foundry, Altoona, Pa.; vice president, George W. Knotts, United Engineering & Foundry Co.; treasurer, William J. Brandt, of W. J. Brant & Co.; secretary, F. H. Zimmers, Union Foundry & Machine Co.; executive committee: H. J. Koch, chairman, Fort Pitt Steel Casting Co.; J. L. Uehler, Union Steel Casting Co.; C. H. Gale, Pressed Steel Car Co.; Byard Phillips, Phillips & McLaren; H. W. Petty, American Steel Foundries, Pittsburgh.

The Hyatt Roller Bearing Co., Newark, N. J., has issued a circular for designers and others interested in bearings, showing in detail the construction of a standard Hyatt bearing utilizing a hollow, flexible roller. Numerous sectional halftone engravings of the Hyatt bearings mounted in journals of different forms also are shown.

Increased Railroad Buying

Domestic Orders and Inquiries More Prominent—Prospects of Large Orders From Foreign Countries

New York, June 22.—Domestic railroads have figured a little more prominently in equipment orders and inquiries during the past week. The receivers of the Rock Island railroad distributed 4,000 steel underframe box cars, of which 2,500 went to the Pullman Co., 1,000 to the Bettendorf Axle Co., and 500 to the American Car & Foundry Co. Receiver's certificates will be taken in payment. The Lake Superior & Ishpeming recently quietly placed 500 freight cars with the Haskell & Barker Car Co., and has closed for 406 ore cars with the Cambria Steel Co. The Chicago & North Western has inquired for 1,500 box cars. Some blocks of cars are being quietly negotiated. The Minneapolis, St. Paul, Rochester & Dubuque traction line has placed 45 box cars and 12 trailers with the J. G. Brill Co.

Further foreign buying of equipment is in sight. Russia is understood to have option on a large number of locomotives, in addition to the 450 recently placed. The Lima Locomotive Corporation received 50 of the locomotives recently given out by Russia and also 64 for France. The 100 locomotives for Russia taken by the American Locomotive Co. are of the Decapod freight type. They have cylinders 25 x 28 inches, driving wheels of 52 inches and weigh 197,000 pounds each. The Central Railway of Brazil has given the American Locomotive Co. three Pacific passenger and three consolidation type locomotives. The Baldwin works has two for the Southern railway. The recent distribution of 3,500 of 10 and 20-ton flat and box cars by the French government railways, it is understood, placed 2,500 with the Middleton Car Co., Middleton, Pa., and 1,000 with the Canadian Car & Foundry Co.

In rails, the Pennsylvania Steel Co. has taken 5,000 tons additional for the Southern Railway; the Bethlehem Steel Co., 2,000 tons of 100-pound sections for subway and elevated lines in New York City and the Lackawanna Steel Co. about 6,000 tons of 75-pound for the Cuban railway. France continues in the market for some large rail tonnages, these coming from various sources in amounts of 100,000, 25,000 and 20,000 tons. A Belgian representative of a London iron and steel firm now in New York is asking 10,000 tons of 90-pound rails, c. i. f. French ports.

Last half standard spike inquiries are more numerous. The New York Central & Hudson River railroad is out for 30,000 kegs, the Baltimore & Ohio for about 20,000 kegs and the Lehigh & New England for 2,000 kegs.

Inquiry at Cleveland

Cleveland, June 23.—Railroad buying in this district has taken a sudden spurt. The New York Central is in the market for 10,750,000 bolts for the Lake Shore division, and the Lake Erie & Western is inquiring for 238,000 bolts and 40 tons of nuts. The New York Central has sent out an order for 3,000 tons of plates, 750 tons of shapes and 250 tons of bars. The Wheeling & Lake Erie is in the market for 1,000 kegs of spikes.

Purchase Approved

Chicago, June 22.—Judge Carpenter in the federal court has given approval to the purchase by the Chicago, Rock Island & Pacific Railway company of 4,000 new freight cars, for which orders have been placed by the receivers at an average price of $850, making a total expenditure of about $3,400,000. Payment for the new equipment has been arranged on a basis of 15 per cent cash and 85 per cent in equipment trust notes at 5 per cent annually, to run 10 years. The equipment notes total nearly $2,890,000. The contract price for the cars is said to be about $300 per car lower than was possible to obtain two or three years ago. Delivery will begin in August.

Car Buying in West

Chicago, June 22.—Activity in car buying is marked in the west. The Chicago, St. Paul, Minneapolis & Omaha is inquiring for 1,000 box cars and another western road is said to be about to come into the market for 2,000 cars. The recent purchase by the Rock Island of 4,000 cars was divided, the Pullman Co. receiving 2,500 cars, Bettendorf Co. 1,000 and the Haskell & Barker Co. 500.

The Phillips & McLaren Co., Pittsburgh, has been enjoying rather heavy demand for its several products, including grinding pans, rock and ore crushers, shears, machinery, etc. It is stated that the company is supplying 75 per cent of the steel foundries in the Greater Pittsburgh district with grinding pans. The United States navy recently placed a repeat order for grinding pans with the company.

(*For complete prices see page* 1344.)

Ferro Prices

For Prompt Delivery Continue to Show Some Variation

New York, June 22.—Spot ferro-manganese continues to bring some variations in prices depending upon the tonnage and how urgently the particular buyer needs the metal. Some recent buyers have put absolute assurance of delivery ahead of every other consideration. A report that an eastern Pennsylvania company about to start a new steel works was able to do less than $100, seaboard, seems without foundation. It is understood this buyer paid at least $100, seaboard, for shipment over the next several months and required an absolute guarantee that a small part of the metal would be delivered in July. A New Jersey consumer bought a carload of domestic at about $105, delivered. One eastern Pennsylvania steel company which has some tonnage of early material available for the market, is holding firmly for $115, furnace, for spot, and, as recently stated, has sold good lots at this figure. Forward English ferro-manganese is quoted at $100, seaboard, but this is a somewhat nominal figure, owing to the indefiniteness regarding delivery. New arrivals the past week have been light.

Only a limited amount of inquiry for ferro-manganese is current, and this usually calls for early shipment. A steel company in the Pittsburgh district has decided not to buy a lot of 400 tons of prompt. A Pacific coast consumer is out for 200 tons. A New Jersey buyer wants a small amount. A moderate buying of domestic spiegeleisen, some of which is for export, continues.

Alloy Inquiry Good

Pittsburgh, June 22.—Several consumers have opened negotiations for ferro-manganese for prompt and future delivery. Material is being held at $105, seaboard, and above, and some sales have been made in eastern territory. It is understood that a Pittsburgh consumer has been negotiating for a tonnage of ferro-manganese, but it is not probable the inquiry will be closed for some time. Spiegel, which is in fairly good demand, is selling at $26, furnace, for small lots. Lower grades of ferro-silicon reflect improvement and minimum quotations seem to be disappearing. Demand for other alloys is described as fairly heavy, but no changes in the position of prices are noted.

Price of Lead Topples

And Prices of Other Non-Ferrous Metals Decline—Almost No Demand for Spelter

New York, June 22.—The metal market during the week closing today has steered an erratic course. In general, prices on the major metals have weakened. The lead market has been featured by a decline which was every bit as sensational as the series of advances which culminated last Monday and Tuesday in the highest price level ever known—namely, 7.75c to 8c, which figures were done by independent producers. The break in the market was due to profit-taking by speculative interests, which had bought heavily on the upward movement. These interests have been offering at heavy concessions. Thus, while the American Smelting & Refining Co.'s price now is 5.75c, New York, which also is the figure most independent producers are asking, resellers are offering lead at 5.25c to 5.37½c, St. Louis. These interests are reported to be doing a good business with consumers.

There has been practically no demand for spelter and there are no indications of any immediate improvement. Prime western is quotable nominally at 18c to 19c, St. Louis, for prompt, and 17c to 18c for July and August. Brass special has been offered at 24c to 25c without attracting buyers. Some producers expect the lower prices on prime western will result in bringing back the galvanizers into the market. The London market yesterday declined £7 10s and today £12 10s.

Copper has been in very poor demand. While the leading selling agencies adhered to their asking prices, second sellers offered concessions. Electrolytic today may be quoted 20c to 20.50c, delivered 30 days. The best brands of casting copper are held at 20c to 20.25c, delivered 30 days, while ordinary casting copper is to be had at 18.75c to 19c, cash. Best brands of lake copper are held at 23c to 23.50c, cash, ordinary lake at 20.37½c to 20.62½c, cash, and arsenical lake at 20.37½c to 20.50c, cash.

Antimony has been quiet, but firm. Spot Chinese and Japanese now are held at 37c to 38c, duty paid. Shipment from the far east is offered at 34.50c to 35.50c, in bond.

Aluminum continues exceedingly strong by reason of the scarcity of the metal. Resellers have sold carloads at 32c and now ask higher. On less than carload lots 35c has been done.

Nickel continues in good demand. Shot and ingots are quoted at 42c to 45c per pound, and electrolytic nickel at 47c to 50c per pound.

The tin market during the week has held up well and a fair volume of business has been transacted with consumers. Today the market is quiet. Prices are about as follows: Spot, 41.30c; July, 39c to 39.50c; August, 38.25c to 38.75c; September, 38c to 38.50c; October, 37.75c to 38.25c. The direct importers are not selling any more June or July and offerings of these months come from second hands. The market continues barren of offers involving guaranteed future deliveries.

Excited at St. Louis

St. Louis, June 22.—There has been a marked decline in lead and spelter prices last week, and the local markets are somewhat in a panic.

Lead was nominally quoted today at $5.50 to $5.75, a decline of 8 cents. Spelter dropped to $15 to $16, or a decline of about $12 from last week's high mark.

Billet Sales

For Forward Deliveries Are Being Made With Caution

Pittsburgh, June 22.—Manufacturers of billets and sheet bars in the Greater Pittsburgh district are asking advanced prices for material for prompt and future delivery. Sheet bars are being held at $22, and billets at $21, mill, by a prominent Pittsburgh maker, but those figures are being shaded by mills in the valleys. Muck bar is listed at $27, Pittsburgh. Wire rods, domestic and foreign demand for which is heavy, are quoted at from $25 to $26, Pittsburgh.

Watching Billet Sales

Philadelphia, June 21.—An inclination to use caution in selling billets, especially open hearth, for forward deliveries, is being shown by eastern Pennsylvania makers, a cue for which seems to have been given by the signs of increasing limitation in the supply in the Pittsburgh district. A number of domestic consumers are inquiring for third quarter and last half contracts and there is a good tonnage of prospective orders for export in the market, but sales are light. Leading eastern Pennsylvania makers are reluctant to sell through the fourth quarter and for third quarter. They now ask $20, Pittsburgh, or $22.56 Philadelphia, for rolling steel with advances of $3 to $4 or more, depending on quality, for forging billets.

Cast Iron Pipe

Prices Are Advanced at Chicago—Little Improvement in East

Chicago, June 22.—Cast iron pipe prices have been growing firmer recently and an advance of 50 cents per ton on all sizes is made this week, to accord with present conditions. A slight change has come about in classification of pipe and a flat quotation for 6-inch and larger is made instead of dividing the quotation at the 12-inch size. The custom has been increasing also of using light weight water pipe of about the same weight as is used for gas mains and light water pipe now is going at an advance of $1 per ton over the standard weights.

Bids have been rejected by Kenosha, Wis., on a large tonnage of intake pipe and it is possible a filtration plant will be built instead of carrying the intake so far into the lake. The United States Cast Iron Pipe & Foundry Co. was low bidder last week on 2,000 tons at Cincinnati. Bids were tons and tenders will be received at opened at St. Louis June 22 on 2,600 Kittman, O., June 29 on 700 tons.

Cuban Contract

New York, June 22.—J. G. White & Co., New York, have taken a public contract for Caibarean, Cuba, and now is in the market for 5,000 tons of cast iron pipe, including 3,000 tons of 14's and some of smaller sizes. The Lehigh Valley railroad has divided among various eastern shops 1,800 tons of 20's, this business being split up in order to get prompt delivery. No action is announced on 1,100 tons of 16 to 24's for Wellesley, Mass. Oakfield, N. Y., is out for about 500 tons of 6 to 10's to close June 24, which is a contractor's letting. R. D. Wood & Co. have taken 1,100 tons of 4 to 8's for Southeastern, Mass., at $24.10, delivered. New tonnage with eastern pipe foundries is keeping up quite well, although there still is need of the larger sizes to balance off operations.

J. G. Gallan, Boston, Mass., has been appointed professor of steam and gas engineering at the University of Wisconsin, Madison, to succeed Prof. H. J. Thorkelson, who recently was elected business manager of the institution.

(For complete prices see page 1344.)

Testing Society Still Grows

Gratifying Increase in Membership Reported at Atlantic City Meeting—Increased Use of Specifications

Atlantic City, N. J., June 22. (By wire.)—With an initial attendance that promises to set a new high mark before the end of the week, the eighteenth annual meeting of the American Society for Testing Materials opened here today at the Hotel Traymore. Notwithstanding the efforts that have been made to curtail the program, 55 committee reports, papers and addresses are scheduled for consideration. A total of 53 specifications will be presented, including 43 proposed new standards and 10 revisions. This is by far the largest number of specifications prepared for any meeting of this organization and reflects the growing recognition of the work of this society. Of interest to the iron and steel industry are the following standards: Heat-treated, high carbon steel splice bars; heat-treated, carbon steel track bolts; heat-treated alloy steel track bolts; lap-welded and seamless boiler tubes for stationary service; welded steel and wrought iron pipe; methods of chemical analysis for alloy steels; iron and steel chain; methods for sampling and analysis of pig and cast iron for export use; open hearth, automatic screw stock; carbon steel bars for vehicle and automobile springs; silico-manganese steel bars for automobile and railway springs; chrome-vanadium steel bars for automobile and railway springs; helical and elliptical springs for railways, alloy steel forging; quenched and tempered alloy steel axles, shafts and other forgings, for locomotives and cars; methods for sampling coal; methods for sampling foundry coke; methods for the sampling and analysis of coal; structural steel for bridges and automobile carbon and alloy steels.

Extended reference was made by Secretary Marburg to the increasing deficit in the treasury and numerous suggestions have been offered to increase the financial returns from the membership. It was recommended that the annual dues for active members be increased $2.50 per annum and $1 for juniors, and also that the dues of corporations and firms be $5 in excess of that for individual members. Since the dues were increased five years ago, the regular publications of the Society have been more than doubled in volume.

The opening session was devoted largely to the consideration of the report of the executive committee and at the second meeting, held this afternoon, the reports of the committees on standard specifications for wrought iron, standard specifications for cast iron and finished castings; standard specifications for coal and standard specifications for coke, were considered at length. The cast iron committee presented revised standards for malleable iron, and methods for the sampling and analysis of pig and cast iron for export use. The sub-committee which revised the specifications for malleable castings worked jointly during the year with a similar committee from the American Foundrymen's Association and also had the co-operation of representatives of the Master Car Builders' Association. The specifications were referred to a letter ballot of the entire committee, consisting of 45 members, of whom 23 voted affirmatively, two negatively and 20 refrained from casting a ballot. Reference was made to the progress made in the formation of a sub-committee on standard specifications for soil pipe and fittings, several conferences having been held with those most interested, but sufficient headway has not been made to submit a definite report. The revision of the present standard specifications for car wheels has been referred to a sub-committee for early attention.

Chain Specifications

Probably the most important work of the committee on wrought iron involved the preparation of standard specifications for iron and steel chain which were adopted without change and referred to a letter ballot of the society. These differ only slightly from those of the Master Car Builders' Association, but members of that organization, who also are members of the sub-committee of the Testing Society, are of the opinion that the Master Car Builders will revise their specifications to conform to those prepared by the Testing Society's sub-committee.

During the year, committee B-2 prepared standard specifications for government bronze, known as the 88-10-2 alloy. The sub-committee on pure metals in ingot form has under consideration the revision of the specifications for spelter and standards for tin were under consideration at the outbreak of the European war. The sub-committee on white metals is at work on lead and tin-base-babbitts. Five or six grades are under consideration and the methods of sampling, analysis and testing are being discussed. The determination of the elastic limit of alloys in tension and compression also is being considered as well as the question of oxidation of bearing metals and some test to show it accurately.

Congress Postponed

Announcement was made that owing to the European war, the congress of the International Association for Testing Materials, which was to have been held Aug. 12 to 17 at Petrograd, Russia, has been indefinitely postponed.

At the last annual meeting, an animated discussion was precipitated by a suggestion to eliminate the letter ballot vote of the entire membership on the adoption of specifications. During the year, a straw vote was taken by the executive committee with a view of ascertaining the sentiment of the membership at large. This resulted in an overwhelming majority in favor of the present procedure and the executive committee accordingly decided to recommend no change in that policy.

After Diamond Steel Plant

Negotiations are being carried on by C. M. Schwab and associates for the ownership of the plant of the Diamond State Steel Co., at Wilmington, Del. This plant has not been in operation for several years and now is owned by Daniel J. Driscoll, of the Delaware Seamless Tube Co., Auburn, Pa., who purchased it some time ago, through the courts. The plant consists of five open hearth steel furnaces, four basic and one acid of 50 tons capacity each, a 34-inch blooming mill, 11 puddling furnaces and eight trains of rolls. The plant, when operated, produced iron and steel splice bars, bolts, spikes, washers, rivets, merchant bars, rods, horseshoes, etc. The purpose for which the works is wanted by Mr. Schwab and his associates is not known.

Plans Completed

The Allegheny Steel Co., Pittsburgh, has completed plans to enlarge its plant at Brackenridge, Pa., for the manufacture of a pressed steel side frame for steel cars. Material for the new addition will be furnished by the 100-inch plate mill of the company. Several new buildings, including one 90 x 126 feet, one 60 x 120 feet and two 30 x 135 feet, will be erected. Considerable new equipment will be purchased.

Boiler Industry Needs Uniformity

Speakers at American Boiler Manufacturers' Convention Plead for Uniform Codes, Laws and Inspection—Meeting at Erie Notable for Attendance and Business Transacted

ERIE, Pa., June 22. (Staff Correspondence.)—A plea for uniformity was the dominant note in all the proceedings of the American Boiler Manufacturers' Association, which concluded its twenty-seventh annual convention here tonight. All speakers emphasized the need of smoothing the difficulties of both boilermaker and boiler user by a closer attention to uniformity in boiler codes, inspections, state laws, cost-keeping systems and contracts.

Practically the full membership of the association was represented at the two days' convention. With the elimination of the social features, decided upon last year, the time was given over entirely to a consideration of the problems confronting the boiler industry.

The initial discussion centered around the standard boiler code adopted by the American Society of Mechanical Engineers and previously approved by the Boiler Manufacturers' Association. This code already has been adopted as standard by several states and its backers aim to eliminate the present inequalities in boiler construction and inspection by securing its approval in all the states.

The boiler manufacturers lined up solidly behind the code and after a two days' discussion decided to form an administrative council to take charge of this movement. The council will comprise members from the Boiler Manufacturers' Association, National Tubular Boiler Manufacturers' Association, Water Tube Boiler Manufacturers' Association, National Boiler and Radiator Manufacturers' Association, and allied interests including inspection and insurance companies, traction engine, crane and locomotive manufacturers.

Through a voluntary assessment upon these manufacturers, a fund will be raised to defray the expense of the council in bringing the attention of the various state legislatures to the need of a nation-wide adoption of the A. S. M. E. code. The assistance of the manufacturers will be enlisted when the code is being considered in their state.

President W. C. Connelly sounded the slogan of uniformity in his address at the opening session. He said in part:

"During the past few years, many changes have occurred in the boiler manufacturing industry. Massachusetts and Ohio were the first states to pass legislation regulating the construction of high pressure steam boilers. I wish to emphasize that this new regulation while welcome to all of us, has certainly curtailed the production of all shops and this has advanced the manufacturing expense to a considerable percentage.

"Legislation regarding 'workmen's compensation' has also increased the cost of manufacture. Although about 30 states have passed laws on this subject, no two are identical. The cost of carrying liability insurance has greatly increased. In 1910, the rate paid by our firm was 40 cents, while today, under the workmen's compensation act, we are paying a rate of $1.76, 400 per cent more than we paid five years ago.

"The expense of conforming to the boiler codes of various states has increased expenses. On one lot of 50 boilers, made to conform to Massachusetts, Ohio, Detroit and Chicago laws, we made out six data forms for each boiler, a total of 300 reports.

"In addition to the need for better cost-keeping systems in boiler shops, is the question of a uniform guarantee clause, pertaining to materials, workmanship and terms of payment. A method also should be worked out by which a boiler made and accepted in any state would be approved by the authorities of other states."

A. B. M. A. Officers

W. C. Connelly, D. Connelly Boiler Co., Cleveland, president; C. V. Kellogg, Kewaneee Boiler Co., Kewanee, Ill., first vice president; G. S. Barnum, Bigelow Co., New Haven, Conn., second vice president; E. C. Fisher, Wickes Boiler Co., Saginaw, Mich., third vice president; Isaac Harter Jr., Babcock & Wilcox Co., New York, fourth vice president; Charles S. Hooker, Union Iron Works, Erie, fifth vice president; J. D. Farasey, H. E. Teachout Boiler Works, Cleveland, secretary; H. H. Covell, Gorton & Lidgerwood Co., New York, treasurer; E. R. Fish, Heine Safety Boiler Co., St. Louis, member administrative council.

A draft of a suggested uniform boiler law was submitted to the convention. It was approved and will serve as a guide to the code committee in its efforts to secure uniform legislation throughout the country. The draft was drawn up by J. Teeter, chief inspector of the Hartford Steam Boiler Inspection & Insurance Co., and Fred R. Low, editor of *Power*.

Cost-keeping systems in boiler shops were discussed by H. D. MacKinnon, of the MacKinnon Boiler & Machinery Co., Bay City, Mich. Replies received to 531 letters sent out by this committee showed a wide divergence in the methods now used, and an absence of any cost system in many shops. In the discussion of this report, which was led by G. S. Barnum, of the Bigelow Co., New Haven, Conn., the need for keeping accurate records of costs was pointed out forcibly. Mr. MacKinnon recommended that the following be considered in figuring overhead costs: Depreciation of buildings and machinery, taxes, insurance, power, heating and lighting, cartage, advertising, workmen's compensation, drafting and estimating, repairs and maintenance of buildings and equipment, salary expense, discount and exchange, all executive and non-productive labor, and interest on investment.

Uniform boiler laws also were discussed by L. E. Connelly, Cleveland; Thomas E. Durban, Erie; H. A. Baumhart, chief of the Ohio board of boiler rules, and John C. McCabe, city boiler inspector of Detroit. The report of the committee recommending a clause for uniform guarantee pertaining to material, workmanship and terms of payment was adopted.

Resolutions of sympathy were adopted and forwarded to the families of Col. E. D. Meier, former president, and Joseph F. Wangler, St. Louis, former treasurer, who died during the past year. Former Presidents Henry J. Hartley, Philadelphia, and Richard Hammond, Buffalo, were elected honorary life members.

This morning the delegates inspected the plants of the Erie City Iron Works, Union Iron Works and Burke Electric Co. At the banquet this evening addresses were given by members of the association and officials of Erie.

Zinc Ore

For New Plant Contracted for by Steel Corporation

New York, June 23. (By wire.)—The Steel Corporation has contracted in Australia for a year's supply of zinc ore for the new spelter plant to be built in the Pittsburgh district. The tonnage is very large. The new plant will have a capacity of about 40,000 tons of spelter and 80,000 tons of sulphuric acid annually.

The report that work will start soon on the new tin plate plant at Gary is not true. This matter is receiving attention in accordance with the original Gary plans, but no early action is assured. Some appropriations have been made for blast furnace stove improvements at the Edgar Thomson plant.

The New Plant

In order to place itself in a protected position on its large requirements of spelter, and its by-products such as sulphuric acid, the United States Steel Corporation has decided to expend from $2,500,000 to $3,000,000 in the erection in the Pittsburgh district of an extensive plant for the manufacture of these products. The new plant, in all probability, will be located at Donora, Pa., nearby the works of the American Steel & Wire Co., which is a large user of spelter and of sulphuric acid. Whether it will conduct the Donora smelter as a part of the American Steel & Wire Co., as a part of the Edgar Zinc Co., or as another subsidiary could not be learned today.

Plant Successfully Started

As recently stated in *The Iron Trade Review*, the Central Steel Co., Massillon, O., poured its first heat of steel June 7. Heats have been taken off continuously and successfully since that time and the company furnishes the following additional information as to the initial operations:

"While there was the usual nervousness attendant with first operations, everything moved smoothly and a successful heat was secured as to quality and uniformity of steel, which consisted of soft basic open hearth steel slabs with the following analyses: Carbon, 0.1; manganese, 0.42; sulphur, 0.030; phosphorus, 0.014.

"On Thursday, June 10, our blooming mill was put into operation and out first ingot rolled into a 4 x 4-inch billet. This was brought down to specified size, rolled perfectly and sheared to required lengths. We are of the opinion it is a record to be able to pour, roll and ship the first heat.

"It will be of additional interest to know that the billets rolled on Thursday were the first that have ever been rolled on all electrically driven and operated blooming mills in this country and what is true of our blooming mill applies throughout our entire plant. All equipment is electrically driven and controlled without a steam line or foot of line shafting or belting in the entire operation. Our electric energy is purchased through our local lighting plant, which has been equipped with every modern prime mover to give us efficient and reliable service."

A. S. M. E. Meets

Big Convention Opens at Buffalo With 500 Delegates in Attendence

Buffalo, June 23. (By wire.)—The spring meeting of the American Society of Mechanical Engineers opened Tuesday evening. More than 200 delegates were registered before Wednesday morning and 500 are expected by Wednesday night. The opening session on Tuesday night at the Hotel Statler was featured by the address of welcome by Frank D. Baird, chairman of the local committee and president of the Buffalo Union Furnace Co. John Brashear, president of the society, responded. In his address, Mr. Brashear described apparatus for photographing projectiles in flight and measuring their actual speed. The opening business session is being held this morning.

More Plants

Will be Placed on the Active List by the Steel Corporation

New York, June 23. (By wire.)—Steady increase in United States Steel Corporation operations continues and the North Sharon plant of the Carnegie Steel Co. has been ordered to resume. This plant will add blast furnace and six open hearth furnaces to the active list. The Columbus works may go in later. Plants now running slightly under 85 per cent of ingot capacity and this figure will be exceeded with additions now planned.

The bookings of the leading producer still keep well ahead of its heavy shipments. New business lately has been 10,000 tons daily over the shipments, indicating a good order increase this month.

Dykes Resigns

Francis Dykes has resigned as president of Milliken Bros., Inc., Staten Island, N. Y., steel fabricators.

Heavy Inquiry

For Rails for Foreign Shipment—Domestic Demand Improves

New York, June 23. (By wire.)—Heavy foreign inquiry for rails continues and total at least 200,000 tons, for which there are good prospects of closing. Some is wanted very promptly, especially tonnage for Russia.

The Cincinnati, Hamilton & Dayton is about to place 2,000 cars. The North-Western's inquiry for 1,500 is for the Chicago, St. Paul, Milwaukee and Omaha.

The American Bridge Co. receives 13,000 to 14,000 tons of steel from contractors for the Brooklyn subway.

Cast Pipe Profits

For Leading Maker Last Year Small, But Show Improvement

The United States Cast Iron Pipe & Foundry Co. reports net profit of $75,599 for the year ended May 31, 1915, which compares with a net loss of $59,867 the preceding year. As no dividends were paid in the year just ended, these earnings were added to the surplus, which brings this account to $253,016. The previous year, however, dividends of 4 per cent were paid on preferred shares, amounting to $500,000, so that the surplus was reduced from $677,417 to $177,417.

Advance High Grade Steels

Leading manufacturers of high speed steels have advanced their prices 10 per cent. The range of prices now quoted is from 60 to 80 cents per pound at the maker's plant, depending upon the quality. The advance is ascribed to the high price of tungsten freely used in the manufacture of high speed and tool steel. Since the war, tungsten has advanced approximately $1 a pound and now is quoted at $1.50 to $1.60 per pound.

New Mill Ready

The Pennsylvania Steel Co. has installed at Steelton, Pa., and now has ready for operation, a 28-inch reversing structural mill, which will fill its requirements on practically all sizes of structural shapes. This mill also may be used for rolling rails. Heretofore, the company has had the capacity for only limited sizes of structural shapes and has been a buyer of considerable tonnage of this product. It also will be able to offer in the market some of the output of the new mill, and now is doing so.

CONTEMPORARY iron and steel literature has been enriched during the present week by a number of highly valuable papers read at the conventions of the American Society of Mechanical Engineers, Buffalo, and the American Society for Testing Materials, Atlantic City. In view of their importance, The Iron Trade Review presents in full practically all of the papers which were presented before Thursday, June 24. The following supplemental table of contents is presented to assist the readers in locating the various papers:

AMERICAN SOCIETY FOR TESTING MATERIALS

	PAGE
A Reagent for Macroscopic Etching... By Jesse L. Jones	1303
Surface Decarburization of Steel... By J. G. Ayers Jr.	1305
Finishing Temperatures of Rails... By E. F. Kenney	1307
Maintaining Galvanizing Standards... By J. A. Aupperle	1310

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Effect of Heat Treatment on Axles... By John Younger	1311
How Humidity Affects Leather Belts... By Wm. W. Bird and Francis W. Roys	1315

AMERICAN IRON AND STEEL INSTITUTE

Progress in Blast Furnace Practice... By A. E. Maccoun	1320

A Reagent for Macroscopic Etching

An Interesting Method of Examining Structure of Steel Without Recourse to the Microscope, Involving Use of Molten Zinc

BY JESSE L. JONES

THE microscopic examination of steels after polishing the surface of small samples and then etching with various reagents, has been brought to a high degree of excellence. Not so much work has been done, however, in rendering visible on a large scale the porosity, lack of homogeneity in composition, hair cracks, blisters, seams, overlaps, slivers and other defects in steel that the rolling or forging treatment has rendered difficult to detect by ordinary visual inspection.

A large user of machinery steel forgings recently obtained, from various steel works, a number of 15-inch ingots and sawed them in half longitudinally. The sawed surfaces when polished showed hundreds of large air bubbles and innumerable small ones, as well as hair cracks in the case of ingots that had stuck in the molds and had not been allowed to shrink freely for this reason. The subsequent mechanical treatment that such ingots receive never altogether removes the porosity and other defects due to the enclosed or occluded air and gases in them. This was proved experimentally by spinning a glass rod about a platinum wire 0.040 inch diameter, so as to give it an impervious coating of glass. The wire thus coated was heated electrically to a red heat in a vacuum and bubbles of air or gas continued to force their way through the glass for several days.

In the making of low, medium and high-carbon steels in the open hearth furnace there is quite a divergence in practice, some makers adding to the steel while in the furnace the ferro-alloys used, while others add them to the steel as it runs into the ladle. Some makers recarbonize while others "bring down" the pig-iron and steel-scrap mixture to the required carbon.

In the case of alloy steels, such as high-speed tool steels which contain notable amounts of tungsten and other metals with high melting points, the tendency to lack of uniformity is more marked than in ordinary steel. These steels are usually made by the crucible process. Plumbago crucibles holding from 90 to 160 pounds (these may be taken as the minimum and maximum sizes used) are placed in regenerative furnaces which each accommodate ten crucibles. These are previously charged with the steel mixture, which consists of sheared muck bar, made from low-phosphorus or bessemer pig iron, ferro-tungsten, ferro-chromium, ferro-manganese, ferro-vanadium, cobalt, etc. The crucibles are tightly sealed so as to keep out the air as much as possible. An effort is made to keep the temperature at the bottom of each crucible at about 3,100 degrees Fahr., or several hundred degrees higher than the top, in order to "lift" the tungsten from the bottom of the crucibles, its high specific gravity and high melting point rendering this necessary. To prevent an undue amount of carbon being taken up by the steel, the crucibles are clay-lined or clay-washed and a

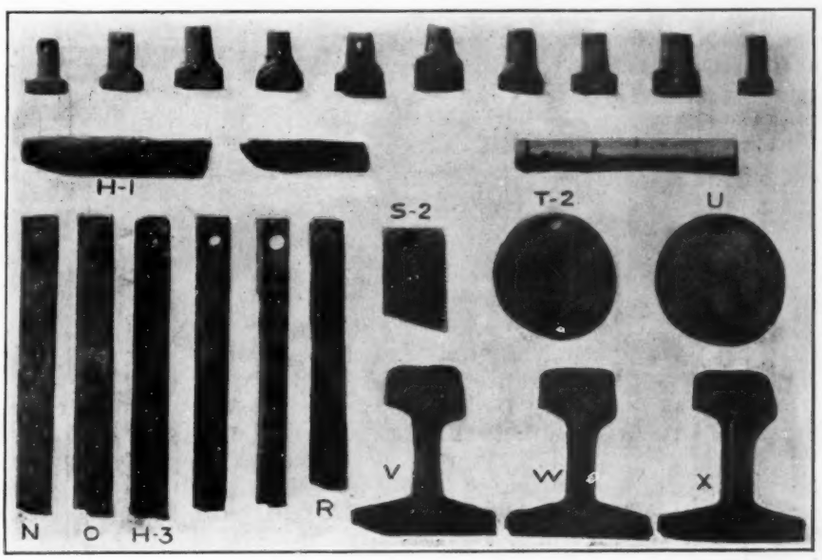

FIG. 1—APPEARANCE OF SAMPLES AFTER ZINC TREATMENT

A paper presented at the annual meeting of the American Society for Testing Materials, June 22-26, 1915.

quantity of crushed soft red brick or similar material is added to glaze over the surface of the crucibles. Even with these precautions the carbon in the various crucibles is different. It has been found that if the crucibles are poured one by one into an ingot mold, a "calico" ingot or one of varying carbon content is produced. Hence the crucibles are emptied into a steel ladle and this is bottom-tapped into the ingot mold, thus giving a more homogeneous ingot.

It is evident from the above review of the processes of steel making that they are far from perfect, and while chemical analysis, microscopic examination and the various physical tests such as tension, Brinell hardness, etc., are more or less satisfactory for the inspection of steel, any improvement in the methods of macroscopic examination would be very desirable. Such an improvement seems to have been found in etching the steel with molten zinc.

How the Zinc Was Used

The writer had occasion recently to ascertain the relative value of open hearth iron, Norway iron and open hearth steel for making pots for hot galvanizing. Bars 10 by 1¼ by ⅜ inch of each of these materials were suspended in the molten zinc in a 14-foot galvanizing pot, by means of iron wires. The samples were placed at the end of the pot because there was no firebox at that point, and hence if one sample happened to be nearer the end of the pot than another it would not for that reason be subjected to a higher temperature. Later, similar samples of carbon tool steel and high-speed steel were added. On taking the samples from the molten zinc the mass of dross surrounding them could be broken off while still hot by blows from a hammer, and the coating of metallic zinc removed by immersion in dilute sulphuric acid, which does not attack the steel as long as any zinc remains. The following table gives the results of this experiment.

Material.	Time of immersion, hours.	Total loss, per cent.	Loss per square inch in 24 hours, per cent.
Open hearth iron	168	2.95	0.012
	336	6.78	0.014
	672	12.79	0.013
Norway iron	168	3.73	0.016
	336	7.46	0.016
	672	14.22	0.014
Open hearth steel	168	3.93	0.017
	336	7.57	0.016
	576	12.80	0.016
	720	15.76	0.016
High-speed steel	24	7.39	0.199
Carbon tool steel	48	21.57	0.348

The appearance of the samples after treatment is shown in Fig. 1, *N* being the open hearth iron, *O* the Norway iron, *H-3* the high-speed steel, and *R* the carbon tool steel. The high-speed steel had its surface deeply pitted and grooved at some points, but the rest of the surface was scarcely attacked at all. The spots that were attacked are probably areas high in carbon, due to imperfect alloying of the ferrotungsten and other additions. These additions are usually high in carbon and also of high melting point. Hence they do not diffuse very rapidly and the resulting mixture may not be homogeneous.

The carbon steel was one not only eaten away to a high degreee, but it also showed a curious shelly structure, the edges being cut away and apparently concentric layers of steel exposed to view as if the steel during the rolling process had not been sufficiently plastic to fill out the grooves in the rolls, and these edges, either because of minute fissures or on account of not being sufficiently compressed to remove

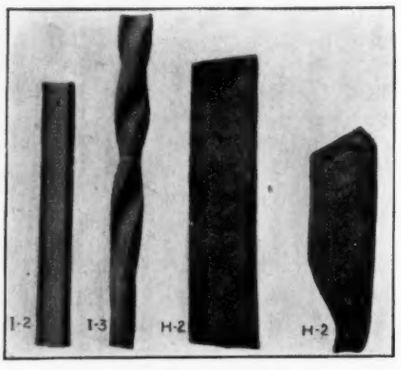

FIG. 2—DEFECTIVE DRILL STOCK AND DRILL

porosity, had readily dissolved in the molten zinc.

Fig. 1 also shows a number of other more or less interesting samples. The sections of bessemer steel rails *V*, *W* and *X*, seemed perfectly solid before etching, but after etching the web part of each sample could be seen to be spongy, the section *X* being especially so. A defective axle that failed in service *U* showed a pipe after etching. A piece of die steel *S-2* was rejected because one surface was badly blistered. On placing this sample in the molten zinc the blistered portion was deeply etched, as seen in the photograph, while the other surfaces remained smooth. The bar of special steel from which sample *T-2* was taken had been very unsatisfactory, the milling cutters made from it nearly all failing. It seemed to be non-uniform in composition.

The high-speed tool steel *H-1* is interesting, as the highly hardened end has not been attacked by the molten zinc, while the other end is eroded in the usual manner. The intense heat to which the point of the tool was subjected in hardening, no doubt, removed the carbon superficially, so that the steel was able to act like a low-carbon steel and thus resist the molten zinc.

Fig. 2 shows an etched sample of high-speed steel drill stock *I-2* that was unsatisfactory and a defective drill *I-3* made from this stock. Two portions of a large high-speed steel planer tool that broke in service are marked *H-2*. Assuming the eroded portions to be brittle high-carbon areas, unable to resist shock under stress, the failure of the tool is understood.

While no specific tests have been made, the readiness with which the molten zinc dissolves highly carbonized steel indicates that this method of testing can be used to show the depth and character of the surface hardening of low-carbon steel that has beeen case-hardened. A few rather unsatisfactory trials have been made of etching nickel steel in molten tin. The use of metallic mercury as an etching fluid and the extension of this method of testing to non-ferrous metals is under consideration. This very incomplete work is described in hope that other investigators may be able to carry it further and develop it into a useful method of macroscopic investigation.

Fire Proof Structures

The Trussed Concrete Steel Co., Youngstown, O., has issued an exceedingly interesting 20-page bulletin illustrating and describing a new form of fire-proof steel and concrete construction for small buildings. It is believed that mining and industrial companies will find this type of construction particularly suited for the erection of dwelling houses in groups. Instead of inflammable wood joists and studs, pressed steel frame members are provided and are so constructed that field riveting is eliminated. The walls consist of metal lath of the well known type manufactured by the Trussed Concrete Steel Co., covered with concrete, stucco or plaster, depending on circumstances. All the necessary details for constructing a complete building have been carefully worked out and it is said that this construction compares favorably in cost with wood. It is also claimed that it requires less than half the time and labor to erect and that the annual maintenance cost is practically nothing.

The prevention of accidents is far more important than compensation for accidents. The whole idea of the safety movement is co-operation with the men.

Surface Decarburization of Steel

How Microscope Can Be Used to Determine Quantity of Surface to be Removed to Eliminate Decarburization

BY J. G. AYERS JR.

WHEN heat-treated steel parts are ground two objects are accomplished; the part is reduced to the finished size, and a suitable finish is given to the surface. When parts are to be subjected to sliding or rolling contact and their ability to resist wear is a desideratum, a third object should be accomplished by the grinding process. This is the removal of any decarburized surface envelope or skin which has been occasioned by the heat treatment, or any prior process in the manufacture of the steel. Under ideal conditions for heat treatment, this decarburization could be reduced to a minimum; but in many commercial hardening operations it is more or less present and is quite frequently ignored. To ascertain to what extent it takes place was the object of the investigation described in this paper.

The microscope was chosen as the most satisfactory means of investigation, for the chemical analysis of successive layers involves a very laborious and painstaking preparation of the samples. It gives, to be sure, a closer approach to the absolute carbon content than can be obtained by the microscope, but this is not a serious drawback as the relative amount of decarburization is all the information generally desired.

In order, however, to examine micrographically the carbon content of a steel, it is necessary to submit the steel to a thermal treatment that will impart a structure in which the carbon-bearing portion or pearlite can be readily resolved from the other constituents. This necessitates heating the specimen to well above its critical range, followed by slow cooling, to obliterate the structure produced by any previous treatment, and to give the most favorable conditions for the complete precipitation of the pearlite. Unfortunately, this process of heating to about 1,000 degrees Cent. is in itself conducive to surface decarburization, and we cannot be absolutely certain whether our conclusions are based upon the condition of the steel as regards carbon content before or after the normalizing treatment. In other words, we are producing possibly the very condition for which we are searching. It is, of course, customary to pack the specimen in some suitable material to prevent this effect, and while this may answer the purpose satisfactorily enough where the extreme surface is not under investigation, it will not do for the purpose under discussion, for the reason that the slightest access of gas included or generated in the packing material may produce an undesired effect. In order to entirely eliminate this condition and to be certain that any decarburization noted had occurred in the heat-treatment or some previous treatment and not in the normalizing, all specimens were normalized in an atmosphere of nitrogen gas. This was readily accomplished by placing the specimen in a small gas-tight refractory tube, through which a stream of nitrogen passed from a tank of the compressed gas. This tube was inserted in a small Haraeus tube furnace to heat the specimen to the desired temperature.

The procedure adopted consisted in first preparing a photomicrograph of a cross section of the specimen to make a preliminary survey under a medium low power. From a study of the photomicrograph of this cross-section, an idea was obtained of the depth of the decarburized zone. As the transition from the zone of minimum to that of maximum carbon content was very rapid in the cross-sectional view, additional longitudinal sections were prepared at such depths below the surface as the cross-section photomicrograph suggested would be of value. From these longitudinal views which traversed zones of fairly

Presented at the annual meeting of the American Society for Testing Materials, June 22-26, 1915.

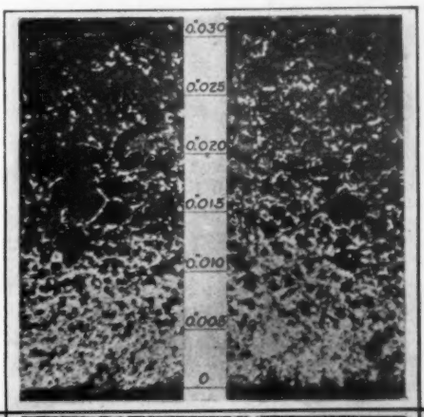

FIG. 1—PHOTOMICROGRAPH OF SECTION ABCD FIG. 9

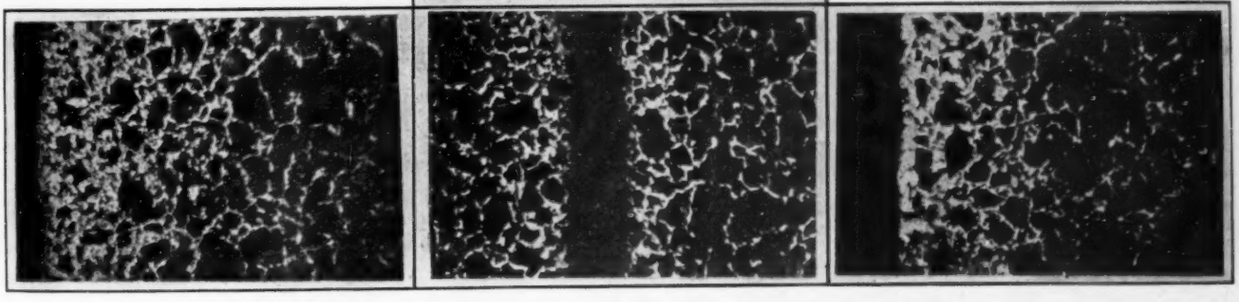

FIG. 2—SMALL HOT-ROLLED SECTION AS FURNISHED BY MILL, MAGNIFICATION 77 TIMES

FIG. 3—SAME STEEL AS FIG. 2 HEATED TO 790 DEGREES CENT. FOR THREE HOURS AND QUENCHED IN OIL—TWO PORTIONS OF THE SPECIMEN ARE SHOWN WITH DECARBURIZED EDGES FACING EACH OTHER—MAGNIFICATION 69 TIMES

FIG. 4—SAME STEEL AS FIG. 2 HEATED TO 790 DEGREES CENT. FOR NINE HOURS AND QUENCHED IN OIL, MAGNIFICATION 77 TIMES

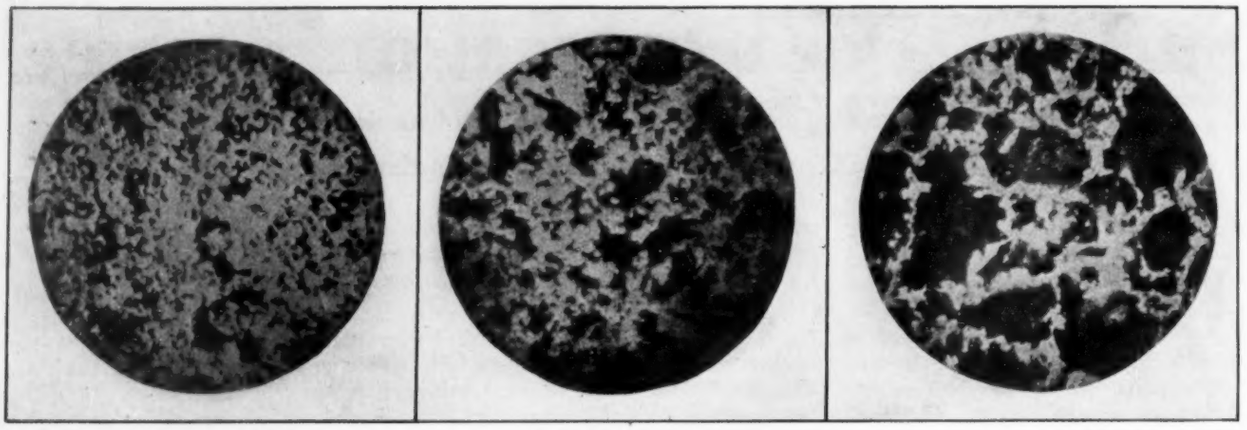

FIG. 5—MICROGRAPH 0.003-INCH BELOW SURFACE, SORBITIC PEARLITE, 25 PER CENT

FIG. 6—MICROGRAPH 0.007-INCH BELOW SURFACE, SORBITIC PEARLITE, 45 PER CENT

FIG. 7—MICROGRAPH 0.013-INCH BELOW SURFACE, SORBITIC PEARLITE, 70 PER CENT

constant carbon content, an estimate of the degree of decarburization could be obtained. Fig. 9 shows the location of the sections of which Figs. 1, 5, 6, 7 and 8 are photomicrographs. Fig. 1 is a photomicrograph showing a cross-section of the steel including the extreme edge of the specimen. Its location is *abcd*, Fig. 9. The scale across the center of Fig. 1 shows that decarburization extends to a depth of about 0.015 inch. About 0.020 inch below the surface the normal carbon content is undisturbed and hence from this an opinion of the degree of decarburization can be formed, although this decarburization is shown much better in the longitudinal views to follow.

FIG. 8—MICROGRAPH 0.023-INCH BELOW SURFACE, SORBITIC PEARLITE, 80 PER CENT

Fig. 5 is a photomicrograph of a longitudinal section 0.003 inch below the surface. It was taken on the plane located by *efg*, Fig. 9, and shows that the degree of decarburization at this depth was very marked. This evidence is in accord with the cross-sectional view just observed above. Sorbitic pearlite occupies only about 25 per cent of the total surface. Fig. 6 shows a longitudinal section 0.007 inch below the surface on the plane *hmn*, Fig. 9. It does not show such marked decarburization, sorbitic pearlite occupying about 45 per cent of the total surface. Fig. 7 shows a longitudinal section 0.013 inch below the surface on the plane located by *opr*, Fig. 9. It exhibits still less the effects of decarburization, sorbitic pearlite occupying about 70 per cent of the total surface. Fig. 8 shows a longitudinal section 0.023 inch below the surface. It is on the plane located by *stu*, Fig. 9, is well within the unaffected zone and is representative of the normal carbon content of the piece. Sorbitic pearlite occupies about 80 per cent of the total surface.

We are now in a position to form an estimate of both the extent and the degree of the decarburization. In estimating the amount of carbon micrographically, care should be exercised to determine exactly upon what micro-constituent the determination is based. If the experimenter's normalizing treatment does not result in pearlite of eutectoid carbon content a factor should be determined for each type of steel handled, and for the particular normalizing treatment; otherwise, determination will often be wide of the mark. This is due to the fact that different rates of cooling in the normalizing treatment result in different phases of pearlite, including sorbite itself. After a factor has once been obtained by chemical check no repetitions need be made.

The specimen under discussion showed about 80 per cent of sorbitic-pearlitic areas in Fig. 8. If we consider them as pearlite containing 0.85 per cent carbon, this view would depict a spot of 0.80 x 0.85, or 0.68 per cent carbon. Chemical analysis gave 0.45 per cent. This illustrates the point dwelt upon above. If, on the other hand, we assume that 80 per cent of sorbitic pearlite corresponds in this particular case to 0.45 per cent carbon, we have a more consistent factor to work by, and hence we deduce the following:

Fig. 5 representing the maximum carbon content of the zone *A*, Fig. 9, shows 25 per cent sorbitic pearlite, or 0.14 per cent carbon; Fig. 6, representing the maximum carbon content of the zone *B*, shows 45 per cent sorbitic pearlite, equivalent to 0.25 per cent carbon; Fig. 7, representing the maximum carbon content zone *C*, shows 70 per cent sorbitic pearlite, equivalent to 0.39 per cent carbon.

If, on the other hand, we desire to ascertain only the relative degree of decarburization in each zone, as compared with the original content, we need no recourse whatever to chemical analysis. Inasmuch as Fig. 8, which represents the zone unaffected by decarburization, contains 80 per cent sorbitic pearlite, zones *A*, *B* and *C*, containing 25, 45 and 70 per cent sorbitic pearlite, respectively, have lost by decarburization about 69, 44 and 12.5 per cent, respectively, of their original carbon content.

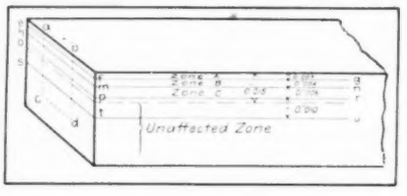

FIG. 9 — LOCATION OF SECTIONS OF WHICH PHOTOMICROGRAPHS WERE TAKEN

From an estimate of this nature, the metallurgist can ascertain just how much should be ground from the piece to satisfy his particular require-

(*Continued on page* 1344b)

Finishing Temperatures of Rails

A Defence of the Shrinkage Test Required by Specifications of American Society for Testing Materials—Pyrometer Measurements Impracticable

SUBMITTED BY E. F. KENNEY
Chairman of Sub-Committee

IN A paper by G. K. Burgess, J. J. Crowe, H. S. Rawdon and R. G. Waltenburg, which was issued by the Bureau of Standards under the title "Observations on Finishing Temperatures and Properties of Rails," published in *The Iron Trade Review*, Sept. 3 and Oct. 1, 1914, the standard specifications for steel rails adopted by the American Society for Testing Materials are criticised as follows: (1) In a general condemnation of the use of shrinkage allowance as the basis of temperature determination, (2) on the ground that the shrinkage permitted is too great.

Theoretically the determination of the finishing temperature of a bar of steel, because of the sensitiveness of the measuring apparatus, should be much more exact than measuring the variation in the change of length of a bar in cooling. There are, however, two reasons why the cruder means is preferable.

In the first place it is much easier to enforce. The mill must set the saws at such a distance apart in the case of gang saws, or at such distance from the stop in the case of a single saw, that when rails are cold they will be within the close tolerances for length prescribed by the specifications. The penalty for not observing this is the milling of every rail to length, and the penalty is so severe in a modern rail mill that there is no question that the proper adjustment of the hot length will be provided. It is not possible for the mill to manipulate the hot length without the knowledge of the inspector, who can without difficulty satisfy himself that any shrinkage-allowance requirements are being observed. The measurement of temperatures of rails by pyrometer is a much more complicated proposition. Carrying the identity of each hot rail as to its observed temperature through the mill and out to the finishing shed where it can be rejected where necessary, would be a difficult and expensive procedure. One or two men would be required to operate the pyrometer and record temperatures, and several men would probably be required to follow up those rails which showed temperatures outside of the limits permitted.

Secondly, the pyrometer measures the temperature at the particular portion of the bar that is under observation. For a simple section this does not vary greatly, but in a complex section, like a tee rail, there is a wide variation in the temperature of the various parts. The records of measured temperatures given in the bureau of standards' paper refer to observations made on the head or at the center of the base. If limiting temperatures were specified and these temperatures were observed on the head or the center of the base, it is quite possible that with the section of the thin-base type, the edges of the flange might be rolled at a temperature below recalescence. The reduction in the rail-mill passes is likely to damage high-carbon steel at this low temperature.

The authors of the paper have taken the maximum shrinkage allowed in the specifications of the society, and by dividing by the coefficient of shrinkage established by their experiments, have arrived at a temperature which they claim could be used in rolling rails, and yet keep within the requirements of the specifications. Such a method of arriving at rolling temperatures is not admissible in the case of unbalanced sections. The shrinkage allowance necessary for rails is a function, not only of the average temperature,

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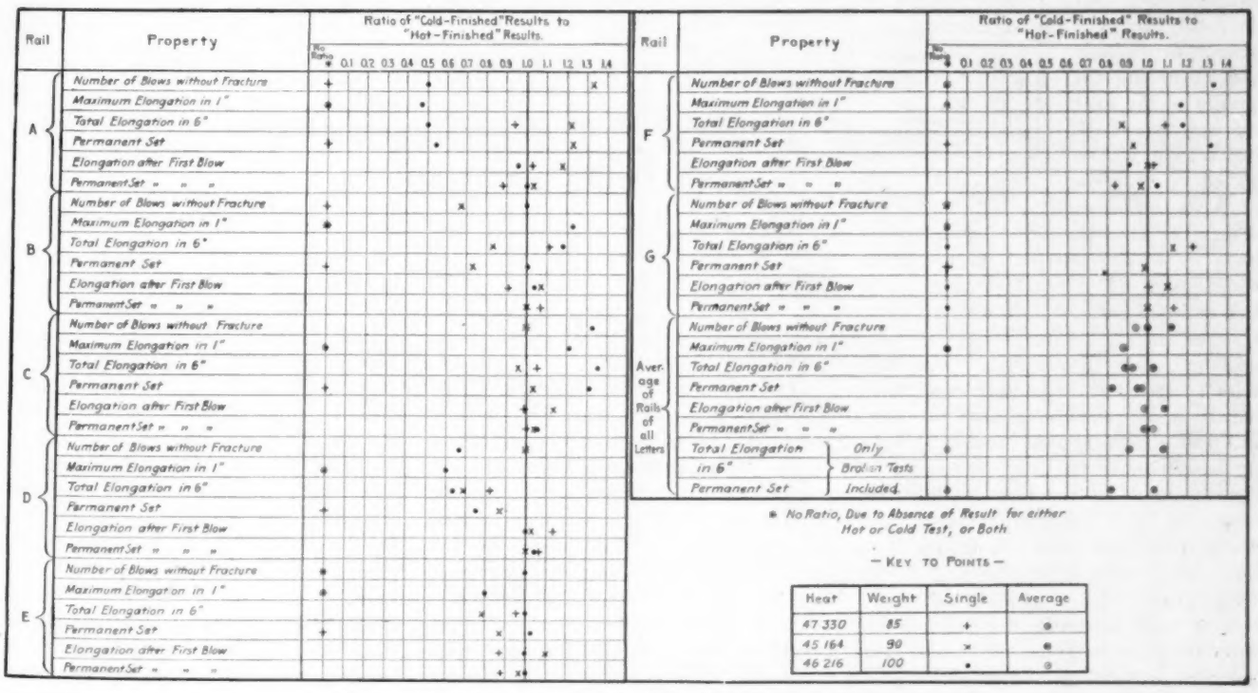


FIG. 1—DUCTILITY AND ELONGATION TESTS OF RAILS

but also of the section. The flanges of a thin-base section cool much more rapidly than the other parts of the section, and in cooling first, they become more rigid than the remainder of the section. When cut by the saws the cooler base and hotter head are of the same length, but as the head has a greater range to cool through, its shrinkage would be greater and cold length less than the base. This is corrected by the cambering rolls, which stretch the head to such length as will compensate for its greater shrinkage.

The shrinkage allowance necessary for any rail is not the shrinkage allowance based on the average temperature of the rail, nor the temperature of the head or base, such as observed in the bureau of standards' experiments; but the shrinkage allowance in sawing, which is necessary for any rail, is the amount of shrinkage of the portion which cools and becomes rigid first. In view of the importance of the subject, it seems very desirable to secure some data as to the effect of the variation in the finishing temperature on the quality of the rail. While there is a large amount of literature bearing on the subject, the actual dependable data regarding the quality of the rails are very scarce. M. H. Wickhorst reported on a series of tests made on bessemer rails, the finishing temperatures of which measured on the heads varied from 940 to 1,030 degrees Cent. and more recently the same investigator reported on a similar series of tests made on open hearth rails. The rails were subjected to drop tests, bend tests, tension tests, transverse tests of base, and the structure was examined under the microscope.

As a result of the tests on bessemer steel rails, Mr. Wickhorst reported "that the ductility and deflection in the drop test were influenced little, if any, by the temperature. The number of blows that it took to break the rails in the drop test was uninfluenced by the temperature of rolling. The yield point and tensile strength in the tension tests were influenced little, if any. The elongation in the tension test decreased some as the temperature increased. The influence of temperature showed most prominently in the tension test, and in the reduction of area, which decreased as the temperature of rolling increased. The size of the grain, as shown by the microscope, increased as the temperature increased."

His conclusions on the open hearth series, which were rolled at temperatures between 695 and 850 degrees Cent., were as follows:

"It may be said that the results in the drop tests, slow bending tests and transverse tests of the base, which were about the same for the different finishing temperatures, varied by holding the rail bar between rolls before final finishing. In the tensile tests the results were also about the same, except that the lower finishing temperatures showed a little greater elongation and reduction of area. The lower finishing temperatures also showed a somewhat finer grain structure."

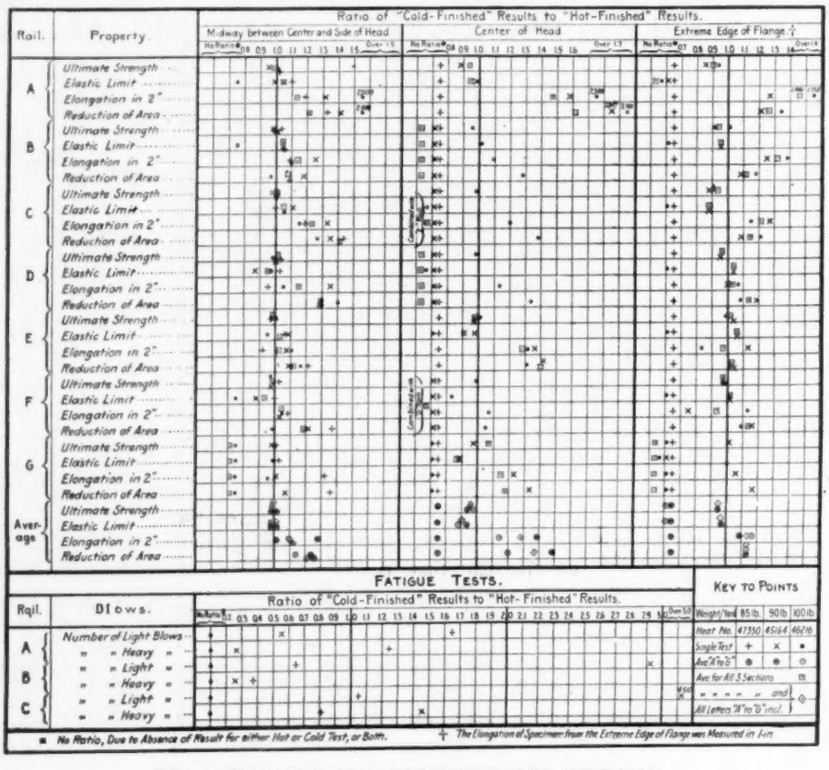


FIG. 2—TENSION AND FATIGUE TESTS OF RAILS

The committee has made an effort to obtain some more data on the subject and has tried to get some actual figures regarding the effect on the service of the rails in track, but on the latter point, nothing other than general statements have been obtained. We are, however, able to submit the results of investigation of the physical properties of the rails finished at various temperatures, as determined by drop tests, ductility tests, tension tests, fatigue flexure tests, and abrasion tests. The work was done by the Illinois Steel Co. the Pennsylvania Steel Co. and the Cambria Steel Co.

In tests made by the Illinois Steel Co. three heats of steel were used, one being rolled in 85-pound rails, one into 90-pound rails and one into 100-pound rails, all of the A. R. A. section, type "A." Part of the rails were rolled at a temperature corresponding to a shrinkage of 6¾ inches, for the 100-pound, 33-foot rails, and part were rolled at a temperature corresponding to a shrinkage of 5⅞ inch for 100-pound, 33-foot rails. The finishing temperatures close to the edge of the flange varied from 880 to 905 degrees Cent. on the hot-finished rails, and from 740 to 760 degrees Cent. on the cold-finished rails. These temperatures were measured at the finishing pass in the rail mill, and are only 50 to 70 degrees Cent. above the critical temperature for rail steel, and were therefore as low as it was deemed advisable to go. In order to show graphically the relation between the results obtained on hot-finished and cold-finished series, results have been plotted and are shown in Figs. 1 and 2. In every case the results obtained on the "hot-finished" rails are taken at unity, while the ratio of the "cold-finished" results to the former are shown either to the right or to the left of the line representing unity, as the values are above or below the corresponding values for the "hot-finished" rails.

Figs. 1 and 2 show that in general there is no marked difference between the qualities of the rails rolled at these various temperatures. The drop tests on the 85-pound rails would indicate that the rails finished at low temperature have slightly better physical properties, but the reverse is indicated on the 90 and 100-pound rails. The tension tests on 85-pound rails also show slightly better properties in the rails finished at low temperatures, but the same test on the 90 and 100-pound rails show decrease in both elastic limit and ultimate strength on the low-tem-

perature rails; while the elongation and reduction of area are increased compared with the rails rolled at the higher temperature.

The fatigue tests show more uniformity in the rails finished at high temperature than those finished at low temperature.

Tests Made by Pennsylvania Steel Co.

The Pennsylvania Steel Co. made tests to determine the relative resistance to abrasion of various rails under conditions approaching those existing in ordinary service. The machine used had a circular track with a revolving carriage equipped with standard wheels, with facilities for adjusting the wheel loads and the speed. The rails to be tested were laid in the track and the amount of metal worn away from the head was measured. Rails finished at temperatures of 850, 990 and 1090 degrees Cent. were tested in the machine at the same time, and the amount of metal worn away was as follows:

Finishing Temperature Deg. Cent.	Shrinkage, inches	Amount of wear, per cent
850	6.4	67
990	7.3	64
1090	7.8	66

The amount of wear is practically uniform.

Tests Made by Cambria Steel Co.

Tests were made by the Cambria Steel Co. on 100 and 125-pound Pennsylvania railroad rails, which were finished at various temperatures ranging between 805 and 885 degrees Cent. The number of blows required to break the rail and the total percentage of elongation measured in the base, which the rail gave before fracture under the drop test, were used to indicate the comparative brittleness and ductility. The results are shown in Fig. 3 and indicate very little effect of the different finishing temperatures within the range of the experiment.

Results of Service in Track

The behavior in track under service conditions is, of course, the ultimate test as to the quality of rails, but there appears to be very little data available to connect the service given by rails with their finishing temperatures. As general information we submit the following statements by J. B. Young, chemist of the Philadelphia & Reading Railway Co., and J. Craig Crawford, assistant engineer of the Pennsylvania Railroad Co.

Mr. Young reported as follows:

"I give below the shrinkage obtained at five mills on both our standard 100-pound section and the 90-pound A. S. C. E. sections:

Mill.	Section.	Shrinkage in.
A*a*....	90-lb. A. S. C. E.	6⅝
A*a*....	100-lb. P. & R. Standard	6¾
B*c*....	90-lb. A. S. C. E.	6½
C*c*....	90-lb. A. S. C. E.*a*	6⅝
C*c*....	90-lb. A. S. C. E.*b*	6¾
C*c*....	100-lb. P. & R. Standard*a*	7
D*b*....	90-lb. A. S. C. E.	6 to 6½
D*b*....	100-lb. P. & R. Standard	6½
E*c*....	90-lb. A. S. C. E.	6⅝ to 6¾
E*c*....	100-lb. P. & R. Standard	6¾ to 7¼

a Bessemer.
b Open hearth.
c Bessemer and open hearth.

"The results of service records show that the 90-pound rails from Mill *A* gave very poor service in the track. The 100-pound rails from this mill gave varying service, but none of it was more than fair and most of it poor. The rails from mill *B* both bessemer and open hearth, gave poor service. The 90-pound bessemer and open-hearth rails from mill *C* gave good service, the service of the open-hearth rails being exceptionally good. The 100-pound rail from mill *C* was all bessemer and has given very good service for bessemer rail.

"The 90-pound rail from mill *D* which was finished with a 6-inch shrinkage was poor. The rail that did not fail is giving good service as to wear, but the failures per 10,000

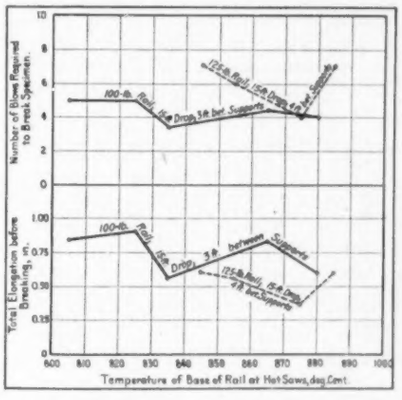

Number of Blows Required to Break Specimen.
100-lb. Rail, 24 Drop, 3 ft. between Supports
125-lb. Rail, 15 ft. Drop, 4 ft. between Supports
Total Elongation before Breaking, in.
100-lb. Rail, 24 ft. Drop, 3 ft. between Supports
125-lb. Rail, 15 ft. Drop, 4 ft. between Supports
Temperature of Base of Rail at Hot Saws, deg. Cent.

FIG. 3—TESTS ON PENNSYLVANIA RAILROAD RAILS MADE BY CAMBRIA STEEL CO.

tons are high. The 90-pound rail from this mill which was finished with the 6½-inch shrinkage has given us good service, the failures per 10,000 tons being practically none. The 100-pound rail from mill *D* has given us very good service, no failures in two years having been reported.

"The 90-pound bessemer rail from mill *E* gave us excellent service in track. We obtained no 100-pound bessemer rail from this mill. Both the 90 and 100-pound open-hearth rails from this mill gave us very good service in track, the percentage of failures per 10,000 tons being comparatively low.

"Judging from the above I would say that we should not reduce our present shrinkage clause, also that the shrinkage should be made a matter of contract, as it is a variable and depends upon the section being rolled, the chemical composition of the steel and the distance of the saws from the finishing pass."

Mr. Crawford reported as follows:

"Our 100-pound rails are finished at about 1650 degrees Fahr., allowing a shrinkage of 6⅝ to 6¾-inch with the exception of rails rolled by the Carnegie Steel Co., which have a shrinkage allowance of from 7 to 7⅛ inches. Our rail records do not indicate that this variation affects the tendency to failure."

In all of the information as to actual tests which the committee was able to obtain, there is lacking anything which points to such decided differences in the quality of rails rolled at varying temperatures, as theoretical considerations have led some of us to expect. The differences are so slight that it seems hardly justifiable to go to any great expense in determining finishing temperatures any more accurately than is possible with the shrinkage clause, which on account of its easy application is by far the most convenient means of checking the finishing temperature.

Engineering Congress

The materials of engineering construction will receive special attention in the proceedings and discussions of the International Engineering Congress to be held in San Francisco, Sept. 20-25. The field will be treated under 18 or more topics, covering timber resources, preservative methods, brick and clay products in general, life of concrete structures, aggregates for concrete, water proofing, volume changes in concrete, world's supply of iron, life of iron and steel structures, special steels, status of copper and the world's supply, alloys, aluminum, testing of metals, of full sized members and of structures.

Some 25 papers are expected for this volume, prepared by authors, representing five different countries. The list of authors includes many of the most eminent names in this field of engineering work throughout the world. These papers, together with discussions contributed by leading American and foreign engineers, will be published as Volume V of the transactions, and will be illustrated with charts, diagrams and half tones.

Merton A. Pocock has been appointed district sales manager of Minnesota, North Dakota and South Dakota of the Terry Steam Turbine Co., Hartford, Conn. Mr. Pocock's office is in the Endicott building, St. Paul, and this arrangement supersedes the Terry company's previous selling agreement with the Robinson, Cary & Sands Co., of St. Paul. The Hawkins-Hamilton Co., Peoples National Bank building, Lynchburg, Va., has been appointed the representative of the Terry Steam Turbine Co. for the state of Virginia.

Grinding wheels appear softer at slow speed because the metal being ground tears the grinding particles away from the bond which holds them together. Don't condemn a wheel as being too soft until you are sure that its cutting speed is correct.

Maintaining Galvanizing Standards

Details of a New Method of Determining the Amount of the Spelter Coating on Sheets and Wire

BY J. A. AUPPERLE

FOR MANY years the Preece copper-sulphate test has been used to determine the amount of galvanized coating on sheet and wire. The committee on the corrosion of iron and steel of the American Society for Testing Materials, reported 1911 on this test as follows:

"It is, however, the unanimous opinion of the committee that the well-known Preece copper-sulphate test is unreliable and should be abandoned entirely as a basis of specification with respect to galvanized sheet and plate. In respect to wire, the Preece test has the advantage of being quick and simple, and if carried out in the proper manner yields comparative results of value. In the opinion of the committee, the lead-acetate test is preferable to the copper-sulphate test for determining or specifying the weight of zinc coatings."

The lead-acetate method recommended by the committee in 1911 yields very accurate and satisfactory results, but the length of time required for making the test seriously limits the scope of its usefulness. The results obtained with the method described in this paper compare very favorably with those of the lead-acetate method.

There is much to be desired in the method of expressing the weight of coating on wire products in order to have an intelligent understanding as to the weight of coating per unit area. It has been customary to express the weight of coating on wire in pounds per mile, while on sheet products the results are usually expressed in ounces per square foot. Obviously, the coating on wire expressed in pounds per mile would have a different meaning for each gage of wire. If the results are expressed in ounces per square foot of surface on both wire and sheets, there will be a better understanding as to the thickness of coating on the respective products. In stating the weight of coating on galvanized sheets it is customary to express the weight based on one surface only, that is, a sheet containing 2 ounces of coating per square foot really contains 1 ounce on each side of the sheet.

It is proposed to express the weight of coating on wire in ounces per square foot, and also to use such lengths of wire that the number of grams of coating found will be equivalent to ounces per square foot, without calculation. These lengths must be such that the surface coated is equal to 5.079 square inches. It is likewise proposed that the samples for determining the weight of coating on galvanized sheets shall be 2¼ x 2¼ inches, the area being 5.079 square inches. The number of grams of coating on a section of this size will also express the weight of coating in ounces per square foot without calculation.

The method for determining the weight of spelter coating consists of using a small amount of antimony chloride in hydrochloric acid, specific gravity 1.20. Antimony chloride appears to hasten the solution of the coating, and after the coating has dissolved a thin film of antimony plates on the surface of the base metal and retards the solution of iron or steel. Experiments have shown that sheet steel 2¼ x 2¼ inch which loses 50 milligrams in five minutes in cold hydrochloric acid, specific gravity 1.20, will lose in that time only 1 milligram in the same acid containing 80 milligrams of antimony per 105 cubic centimeters of acid.

LENGTHS OF WIRE TO GIVE GRAMS OF COATING EQUIVALENT TO OUNCES PER SQUARE FOOT

Gage No.	Diameter, in.	Length for Test, in.	Length for Test, cm.
0	0.340	4 12/16	12.1
1	0.300	5 6/16	13.7
2	0.284	5 11/16	14.5
3	0.259	6 4/16	15.9
4	0.238	6 13/16	17.3
5	0.220	7 6/16	18.7
6	0.203	7 15/16	20.2
7	0.180	9	22.8
8	0.165	9 13/16	24.9
9	0.148	10 15/16	27.7
10	0.134	12 1/16	30.6
11	0.120	13 8/16	34.2
12	0.109	14 13/16	37.7
13	0.095	17	43.2
14	0.083	19 8/16	49.5
15	0.072	22 7/16	57.0
16	0.065	24 14/16	63.2
17	0.058	27 14/16	70.8
18	0.049	33	83.8

In the proposed method the metal is immersed in the acid only one minute, which is long enough to dissolve several grams of coating, yet the amount of iron or steel dissolved is negligible. The small amount of antimony that plates on the surface of the sample can easily be removed by scrubbing under running water. This method is one of the most rapid and accurate with which the writer is familiar, and a determination can be made in less time than is occupied in making the Preece test.

For determining the weight of coating on galvanized sheets cut several samples 2¼ x 2¼-inches from various parts of the sheet. These samples, about five in number, should be weighed together and immersed singly for one minute in 100 cubic centimeters of hydrochloric acid, specific gravity 1.20, to which has been added 5 cubic centimeters of antimony chloride prepared by dissolving 20 grams of antimony trioxide in 1,000 cubic centimeters of hydrochloric acid, specific gravity 1.20. The same 100 cubic centimeters of hydrochloric acid can be used for at least five samples. Five cubic centimeters of the antimony chloride, however, should be added for each sample on account of the antimony being removed from the solution by the iron.

The samples are washed and scrubbed under running water, dried with a towel, and laid in a warm place for a few seconds. The samples are again weighed together and the number of grams lost is divided by the number of samples taken. Each gram corresponds to one ounce of coating per square foot.

A small section of the galvanized wire should be stripped in hydrochloric acid containing antimony chloride. The diameter of the black wire should then be carefully measured in order to determine the length of wire, such that the number of grams of coating will represent the number of ounces per square foot of surface. These lengths are given in Table I. In the lighter wires, however, it will be found convenient to use some fraction of these lengths.

The method of making the test is very similar to that outlined for galvanized sheets, except that the wire is first cleaned with carbon tetrachloride or gasoline and after being carefully weighed is placed in a tall glass cylinder containing hydrochloric acid, specific gravity 1.20, to which has been added from two to three cubic centimeters of antimony-chloride solution of the same strength as used on galvanized sheets. The reason for using one-half the amount of antimony chloride in the case of wire is on account of taking one-half the area. As previously stated, the coating on galvanized sheets is expressed in ounces per square foot, considering one

(*Continued on page* 1319)

A paper presented at the annual meeting of the American Society for Testing Materials, June 22-26, 1915.

Effect of Heat Treatment on Axles

Interesting Results of an Investigation to Increase the Strength of Axle Shafts for Motor Trucks—Effect of Heat Treating

BY JOHN YOUNGER

IN THE following description of an investigation made to determine the cause of failure of an axle shaft of a large motor truck, the methods pursued and the remedy adopted may prove of value in future designs of similar structures. The result has a very much wider application than to motor trucks, and is testimony to the value of heat-treated steels.

The design of the shaft and adjacent parts is shown in Fig. 2. The flutes or splines at the ends are slightly loose so that it is under no constraint except to move in a rotary path and is intended to be subject to pure torsional stresses, with no complicating bending effects. The shaft is shown in Fig. 3. It was made from a 2¼-inch chrome nickel bar, turned all over to 2.1235-inch diameter.

The particulars of the motor truck upon which all calculations must be based are; motor develops 44 horsepower at 1,000 revolutions per minute under average conditions, transmission reduction is 3.77 to 1, worm gear reduction is 9.75 to 1, total reduction, 36.8 to 1.

Presented at the Buffalo meeting of the American Society of Mechanical Engineers, June 22-25.

FIG. 1—CHARACTERISTIC FRACTURE, SHAFT TURNED DOWN

Tests have shown that the efficiency of the transmitting mechanism between motor and axle shafts on this gear ratio is about 75 per cent. Therefore 33 horsepower is transmitted as a maximum by the shafts at 27 revolutions per minute.

The specifications of the steel were as follows:

CHEMICAL.

	Per cent.
Carbon about	0.20
Chromium about	1.50
Manganese about	0.30
Nickel about	4.00
Silicon about	0.20
Phos. and sulphur below	0.04

PHYSICAL.

	Pounds per square inch.
Elastic limit	90,000
Maximum strength	105,000
	Per cent.
Reduction in area	66
Elongation	25

The shafts broke in service as shown in Figs. 1, 4, 5 and 6.

In common with usual road vehicle practice, a differential gear is fitted, the power transmitted by each shaft at each wheel being only half the total. The shaft shown in Fig. 3, therefore,

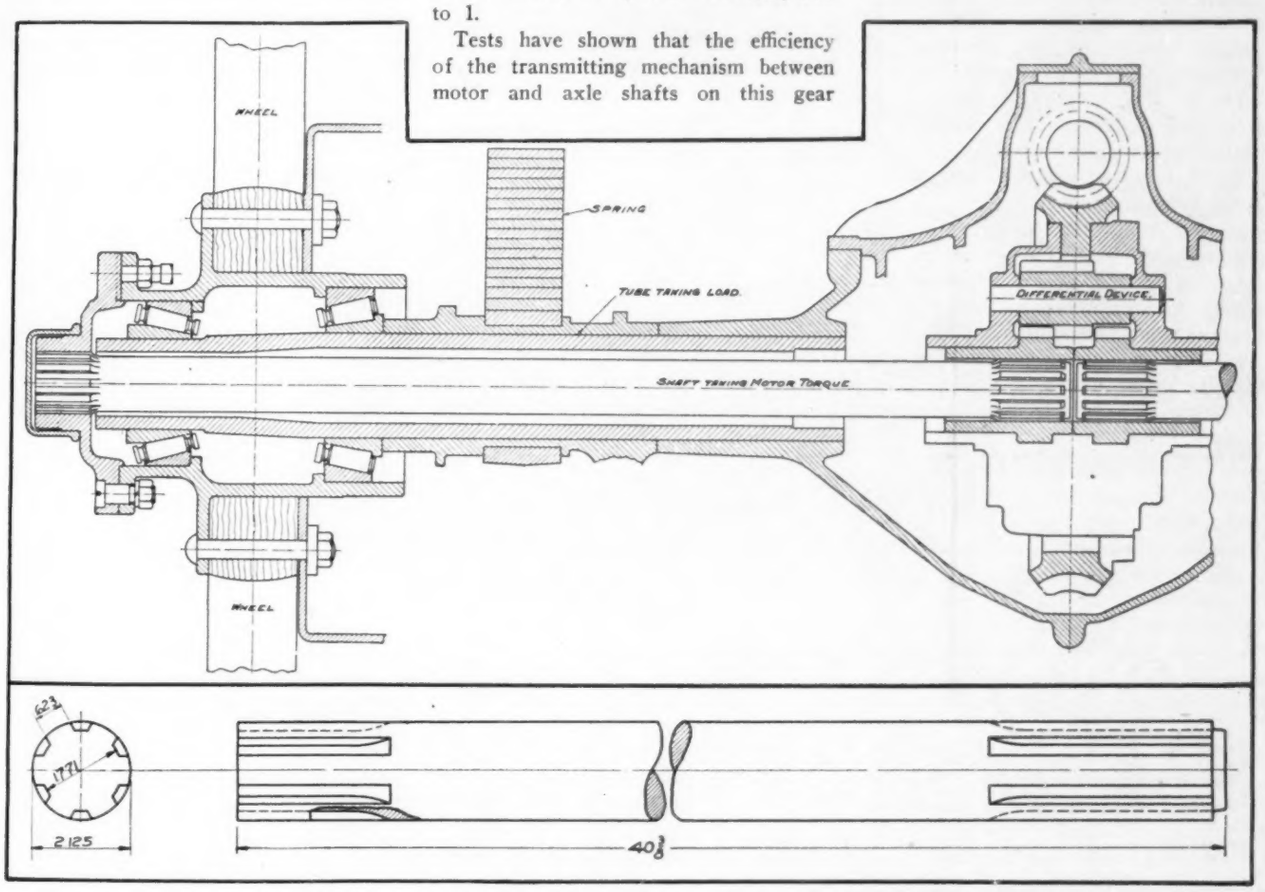


FIG. 2—DIAGRAMMATIC DESIGN OF TRUCK REAR AXLE SHOWING LOCATION OF SHAFT
FIG. 3—THE ORIGINAL SHAFT

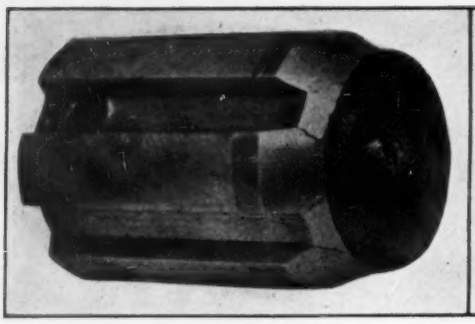


FIG. 4—EFFECT OF SPLINE

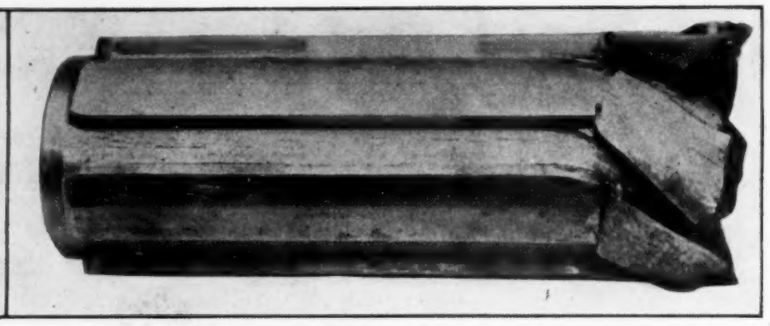


FIG. 5—CHARACTERISTIC FRACTURE

is under maximum pure torsional stress due to the transmission of 16½ horsepower at 27 revolutions per minute.

Effective Diameter of Shaft

The next question was to determine the effective diameter on which to base calculations of stress. The large diameter of 2⅛ inches would not be accurate as the flutes at the ends weaken the shaft to a considerable extent. This fact is obvious from Figs. 1, 4, 5 and 6, where the lines of cleavage are clearly seen to start from the corner of the spline. Although a sharp corner is a very dangerous source of weakness, it was impossible to get a radius of more than 0.02 inch at the fillet without reducing the area of bearing surface. Key seats or splines are always weakening elements, but it is impossible to do without them. C. E. Larard, member of the Institution of Mechanical Engineers, London, read a paper in 1911 before the Institute of Automobile Engineers on "Strength of Castellated or Splined Shafts," the results of his investigations being shown in the accompanying table.

In the table, the diameters of the plain shafts were the same as the diameters of the splined shafts at the bottom of the key-ways. The limit of elasticity and the torque at fracture for the splined pieces are shown to be slightly greater than for the plain. However, in work required to produce fracture, it is shown that more energy is required to break the plain shaft than the splined. Mr. Larard points out this difference, but does not account for it. It would certainly seem as if the projections should give added strength to the shaft; but in the ultimate, their presence seems to hasten its downfall.

FIG. 6—CHARACTERISTIC FRACTURES PARALLEL SHAFT

This is borne out by the appearance of the fractures in Figs. 4, 5 and 6.

It would seem that while the splines add a slight extra strength to the shaft under static conditions, they subtract from it under dynamic conditions where fatigue is likely to result. Taking the energy required to fracture as shown in the table, the plain shaft could be considered 30 to 60 per cent stronger than a shaft with splines added. The immediate conclusion therefore would be that calculations for strength should be based at most on the diameter at the bottom of the splines.

In order to test the value of this conclusion in practical fashion, a truck was loaded up to full five tons capacity. Its rear wheels were then anchored somewhat in a cradle, which allowed about 6 feet of travel, as shown in Fig. 7. A driver then made the truck surge too and fro, the extent of the alternations being measured. The aim was to give the maximum stress on the axles by obtaining the full force of the motor as well as the rotational energy of the flywheel acting against the inertia of the truck. One shaft was left parallel in its length, the other was turned down in the center. The former broke first and the latter some little time after, 5,141 blows being necessary. The total twist in the second exceeded 700 degrees, whereas the twist in the first was through an exceedingly short length; all being concentrated near the end of the splines, Fig. 5. In Fig. 8 is shown the beginning of the planes of cleavage.

From this test it is evident that the diameter at the bottom of the splines should be taken in calculations for strength. Accordingly, the design was changed to that shown in Fig. 9, in which the diameter at the bottom of the

Strength of Splined Shafts

Form of specimen	Diameter of specimen		Particulars of key way		Limit of elasticity in pound-inches	Ratio of elastic torque to elastic twist	Modulus of rigidity		Diameter of equivalent elastic shaft	Elastic resilience to limit of elasticity in inch-pounds		Torque at fracture in pound-inches	Work to produce fracture in inch-tons			Ratio of plastic work to elastic resilience	Angle of torsion		
	Outside	Bottom of keyway	Width	Depth at edge			Lbs. per sq. in.	Tons per sq. in.		Per unit length	Per unit volume		From instrument readings on 8 in.	Per unit length	Per unit volume		By instrument on 8 in. length	Per unit length	Angle of helix
	In.	In.	In.	In.					In.								Deg.	Deg.	D. M.
Castellated	2½	2	½	3/32	16,100	53,080	....	.....	2.144	5.266	1.251	135,000	457.16	57.14	13.58	24,300	545	68.1	33 57
Plain	2	..	..	..	14,800	40,000	11.68×10^6	5,215	.....	5.970	1.9	90,800	438.6	54.83	17.44	25,890	740	92.5	41 29
Castellated	1 37/64	1 33/64	7/32	7/32	7,400	17,420	....	.....	1.623	3.429	1.484	57,700	257.0	32.12	13.89	20,980	708	88.5	34 17
Plain	1 33/64	..	..	..	6,400	13,720	12.01×10^6	5,380	.....	3.256	1.804	41,600	281.5	35.19	19.51	24,200	1,034	129.25	30 20
Castellated	1 5/16	1 1/16	11/64	1/8	4,430	9,166	....	.....	1.382	2.334	1.283	38,000	161.7	20.21	11.10	20,490	690	86.25	39 16
Plain	1 11/64	..	..	..	3,850	8,387	11.79×10^6	5,265	.....	3.049	2.127	28,100	195.6	24.45	17.07	17,960	1,040	130.0	33 9
Castellated	1¼	1	¼	1/8	2,750	3,300	....	.....	1.070	2.498	2.39	16,550	101.1	12.64	12.11	11,330	999	124.9	36 17
Plain	1	..	..	..	2,680	2,568	11.47×10^6	5,120	.....	3.048	3.812	11,700	122.6	15.32	19.16	11,260	1,563	195.4	30 9

splines is 1.75-inch. The shaft formula gives:

Maximum stress per square inch $= \frac{321{,}000 \text{ h. p.}}{nd^3}$

$= 36{,}500$ pounds per square inch, approx. This gives a factor of safety of 2.5 based on the elastic limit, or 2.9 based on maximum tensile strength.

This particular design of truck has a powerful brake located near the transmission, so that all the braking effort is transmitted by the rear axle shaft to the wheels. It is safe to assume a maximum load on each rear wheel of 8,000 pounds and a coefficient of adhesion of the rubber tire to the road, of 0.6. The diameter of the wheels is 40 inches, so that torque on shaft is 96,000 inch-pounds. It is probable that this torque is not obtained owing to the elastic rubber tires absorbing part of this blow. Assuming that it were obtained, there would be a maximum stress of 93,000 pounds per square inch set up in the axle from the formula

$$\text{Twisting moment or torque} = \frac{\pi f r^3}{2}$$

The above loads are not normal working loads, but are the maximum that can be expected.

It is obvious, therefore, that the shafts which have broken may have been considerably overstressed, although a large number of these actually ran 30,000 to 40,000 miles before breaking. For this reason, it was felt that a comparatively small increase in strength might be sufficient to prevent such breakages and experiments were made to determine the governing factors. The necessity for this was that it was almost impossible to increase the diameter of the shafts, which was, of course, the obvious step to take. A study of the results of Mr. Larad's paper, and of the fractures shown in Figs. 1, 4, 5 and 6, showed that large splines were a very grave source of weakness. If each spline is considered as a small cantilever of breadth $2b$ jutting out from the shaft, with a load of $2W$ upon it, the bending moment at the juntion will be $2Wb$. If double the number of splines are taken, but the same total bearing area retained, each spline will have half its former breadth and carry half its former load. The bending moment will then be $\frac{Wb}{2}$, or only one-fourth of what it was before, Fig. 10. In addition to the gain in strength by this change, the diameter of the shaft at the bottom of the splines can be increased by the height of one spline, while the outside diameter is kept the same.

It was felt that as the strength should be calculated from the diameter at the bottom of the splines, it would be advisable to turn down the shaft in the middle and so reap the advantage of having it uniformly strong throughout its length, and avoid trouble due to sudden changes in torque-resisting values.

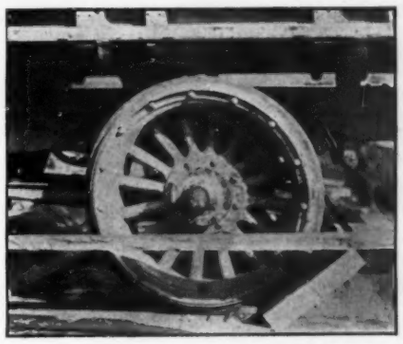


FIG. 7—CRADLE IN WHICH TRUCK WAS TESTED

This gave the shaft shown in Fig. 11, in which 12 splines were used, with the effective diameter increased from 1.75-inch to 1.8965-inch. This was an increase in strength of $\frac{1.93}{1.753} = \frac{6.86}{5.36} =$ 28 per cent, approximately.

The body of the shaft was ground and polished to avoid all scratches. It was found from examination of fractures that the slightest flaw was enough to start a breakdown. Particular attention was given to the junction of the main body of the shaft with the parts of larger diameter used for the splines, to avoid grooving of the filleting tool. It is interesting to note in this connection that the cause of failure of an axle shaft on a locomotive tender on Sept. 19, 1914, involving the wreck of a passenger train on the B. & O. railroad, was directly attributed to the presence of serrations or score marks on the surface of the axle. Their presence caused the axle to fail gradually under the influence of the dynamic stress to which it was subject. A full report of this was given in *The Iron Trade Review*, March 20, 1915, and is very interesting reading.

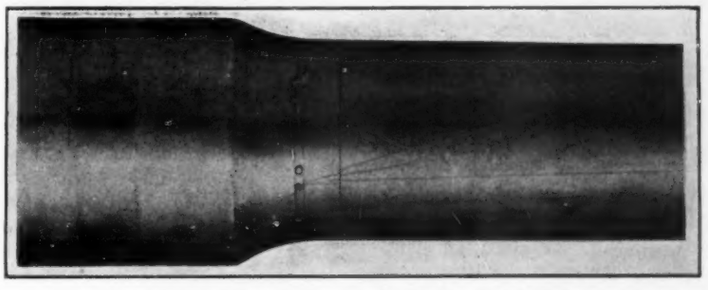


FIG. 8—LINES SHOWING PLANES OF CLEAVAGE IN A SHAFT ABOUT TO BREAK

The designer naturally looks first to the manufacturing end as the cause of his troubles and one of the first investigations was to make sure that the axle was subjected to pure torque and not a combined bending and twisting stress. Six complete axles, some of which had run up large mileage with no fracture, while the remainder had fractured early, were inspected in detail. No difference was found, the only errors present being those that fell within what could only be considered as limits of tolerance. This disposed effectually of improvement being effected in the machining process. Unfortunately the improved shaft, while somewhat stronger and of longer life, also broke down in the long run, and further improvement was desired.

This left only the material question to be studied. The impression had been that the best material available was being used and certainly the physical tests indicate a high grade of alloy steel. It has been noticed, however, that the energy required to fracture a piece of ordinary soft mild steel was practically the same as that required to fracture an exactly similar piece of high-grade alloy steel.

Mr. Larard in his paper also noted this fact, finding that the work required to twist 3 per cent nickel steel shafts, oil hardened, was about the same as that required with soft carbon-steel shafts. Several tests have shown that a soft steel bar requires more energy to break it than does a hardened bar. The question, therefore, at once suggested itself: Should the shaft be of a softer steel capable of twisting more under a suddenly applied load, and afterwards returning to normal conditions; or should it be of a very much harder steel, which would be more rigid and not deflect so much, but which would require a greater load to break?

A careful examination of printed matter shed no light on the subject. Engineers habitually specified maximum elongation and reduction of area, with the idea that they were getting great toughness. A large number of tests of

pieces under fatigue seemed to give all kinds of results; and after witnessing many tests the conclusion was reached that the probable reason for such variation was, that the elastic limit was not what it seemed, but very much lower, and that steels stressed just over the real elastic limit behaved differently from those that had not been stressed to this point. By far the greater number of tests of steel have been made to see how they will break, and very few as to how they will not break.

It was reasoned therefore that if the elastic limit could be raised materially, the shafts would stand up better. Experiments made with small heat-treated specimens, which could be bent by hand, indicated that this was on the right path and accordingly, after some experiments, two shafts were heat-treated to 175,000 pounds elastic limit and tested on a truck in very severe service. These stood up.

Further tests showed the desirability of increasing the carbon content somewhat, and several shafts were made to the new specifications and sent out on hard service with excellent results. The material was a domestic steel of the following characteristics:

CHEMICAL

	Per cent.
Carbon about	0.30
Manganese	0.50
Chromium	1.50
Nickel	3.50

PHYSICAL

	Lb. per sq. in.
Elastic limit	175,000
Tensile strength	185,000
	Per cent.
Elongation per cent in 2 inches	14
Reduction of area	53

These experiments proved so satisfactory that in September, 1913, a number of these heat-treated shafts were sent out to replace others. None of these nor the original experimental shafts have broken.

The shafts are machined from hot-rolled bars already heat-treated to show an elastic limit of about 100,000 pounds. They are then heated in a gas furnace to a temperature of between 1,450 and 1,500 degrees Fahr., and quenched in oil. This double treatment insures the grain being properly refined. They are then reheated to a little over 700 degrees Fahr., and allowed to cool slowly in air. Some trouble was experienced at first with warping, but slight experimenting showed they could be readily straightened when hot, under a press. Each individual shaft is then put under the Brinell hardness machine, and its Brinell number read at the ends and the middle of the bar. This should be 402 to 444. It is then wrapped around with a metal tag, Fig. 12, used with the idea of getting reliable results on the different steels tried out in the search for a suitable material. In this connection it is interesting to note that 5 per cent nickel steels, chrome vanadium steels, and air hardening steels were tried out and so far all have been standing up to service.

It was thus definitely established that under pure torsional conditions the strength of a shaft is increased by increasing its elastic limit by heat treatment.

It would naturally follow, therefore, that similar results could be expected from other components under tensile or shear stress, and accordingly greater attention has been paid to heat treating. The elastic limit has been raised in many pieces with corresponding advantage and in addition as a special measure of precaution each important structural forging or bar is submitted to test on either the scleroscope or the Brinell machine to insure that the piece has been properly treated. Both these machines give very reliable readings which can be directly compared with the elastic limit. By their use a number of forgings apparently all right, but actually either too hard or too soft, have been detected.

As regards the economic aspect of the use of heat-treated steels, it is found that this process costs between 2 and 2½ cents per pound and as the strength can in many cases be nearly doubled it clearly effects a large saving. Alloy steels, properly heat treated, are indispensable for motor truck work, as their capacity to resist fatigue is very great.

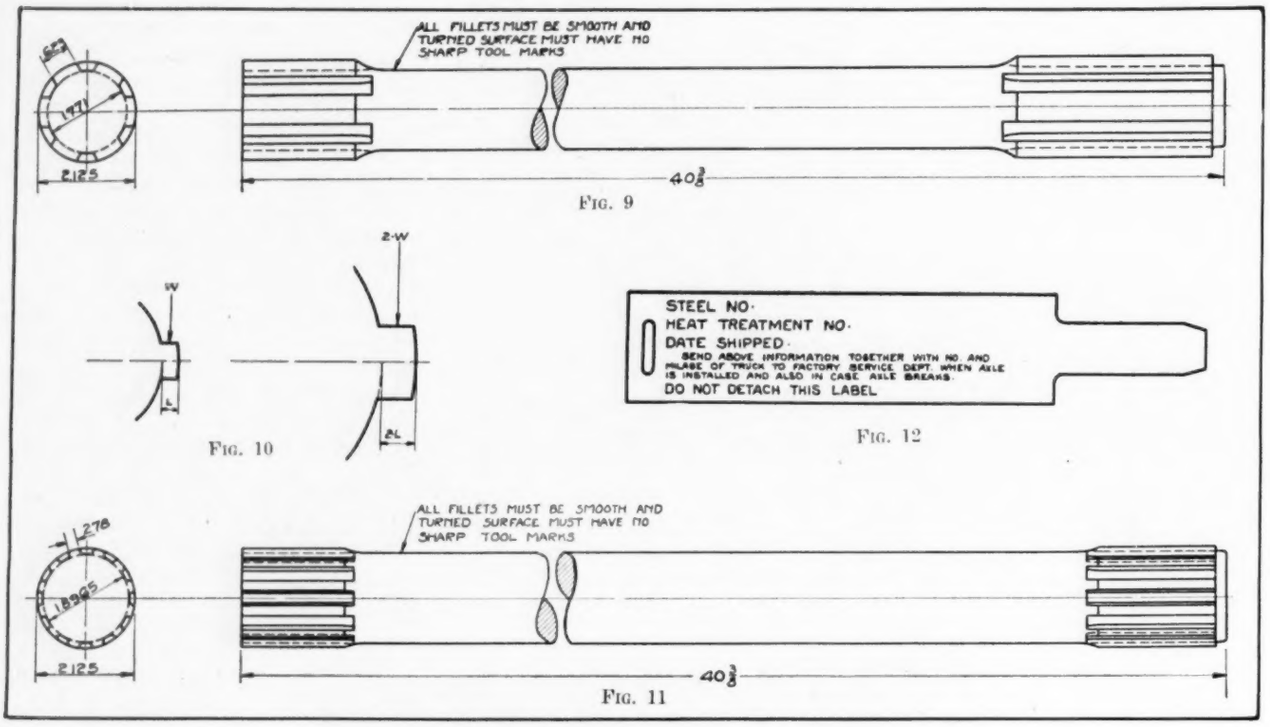

ALL FILLETS MUST BE SMOOTH AND TURNED SURFACE MUST HAVE NO SHARP TOOL MARKS
2.125
40⅜
ALL FILLETS MUST BE SMOOTH AND TURNED SURFACE MUST HAVE NO SHARP TOOL MARKS
2.125
40⅜

FIG. 9

FIG. 10

STEEL NO.
HEAT TREATMENT NO.
DATE SHIPPED.
SEND ABOVE INFORMATION TOGETHER WITH NO. AND MAKE OF TRUCK TO FACTORY SERVICE DEPT. WHEN AXLE IS INSTALLED AND ALSO IN CASE AXLE BREAKS.
DO NOT DETACH THIS LABEL

FIG. 12

FIG. 9—SECOND DESIGN OF SHAFT

FIG. 10—EFFECT OF DOUBLING SPLINES AROUND THE CIRCUMFERENCE

FIG. 12—LABEL ATTACHED TO EACH HEAT TREATED SHAFT

FIG. 11—FINAL FORM OF NEW SHAFT

How Humidity Affects Leather Belt

Details of Experiments Made on the Action of Leather Belts During Changes in Relative Humidity—Results Obtained

BY WILLIAM W. BIRD AND FRANCIS W. ROYS

IT IS A recognized fact that the weather has a more or less noticeable effect on leather belts. In experimental work it has often been found impossible to duplicate results when testing the same belt on different days. In practice, those who are famaliar with the behavior of leather belts have noticed a difference in the action of belts from day to day, under varying conditions of the weather. However, when the generally accepted rules for belting are consulted, it will be found that the discussion of the weather has been entirely left out for once. Of the several weather conditions which can be noted readily, it was thought that the variation of the relative humidity of the atmosphere would offer the most promising field and therefore the effect of this variation was chosen as the subject of a special investigation.

After several months of preliminary work, with uncertain conclusions and very discouraging prospects, it was decided that, if anything definite was to result from the experiments, the effect of many of the variables would have to be eliminated by keeping most of the conditions constant.

The most noticeable effect of an increase in the humidity was found to be the lengthening of the belt. If the distance between the pulley centers remained constant, this lengthening of the belt would decrease the sum of the tensions. On the other hand, the sum of the tensions could be maintained by varying the center distance as the humidity was changed. Thus the field being narrowed to these limited conditions of constant initial length, width, thickness and speed of the belt; diameters of the pulleys; horsepower transmitted, and temperature, the investigation was carried out to determine:

First—The effect produced on the center distance by varying the sum of the tensions, the relative humidity remaining constant.

Second—The effect of the relative humidity on the center distance, the sum of the tensions remaining constant.

Third—The effect of the relative humidity on the sum of the tensions, the center distance remaining constant.

A general layout of the apparatus used in these experiments, which were conducted at the Worcester Polytechnic Institute, is shown in Fig. 1. The shaft used carries a pulley on one end and an Alden dynamometer on the other and is mounted on a carriage which is free to move in a horizontal direction at right angles to the shaft. On the same level with this first shaft and parallel to it, is a jack shaft driven at constant speed. This jack shaft has a pulley on one end the same size as the pulley on the dynamometer shaft and the belt under test runs over these two pulleys. The Alden dynamometer furnishes the load which is equivalent to $T_1 - T_2$ or the difference between the tensions of the tight and slack sides and the platform scale weighs the sum of the belt tensions or $T_1 + T_2$, as shown in the illustration.

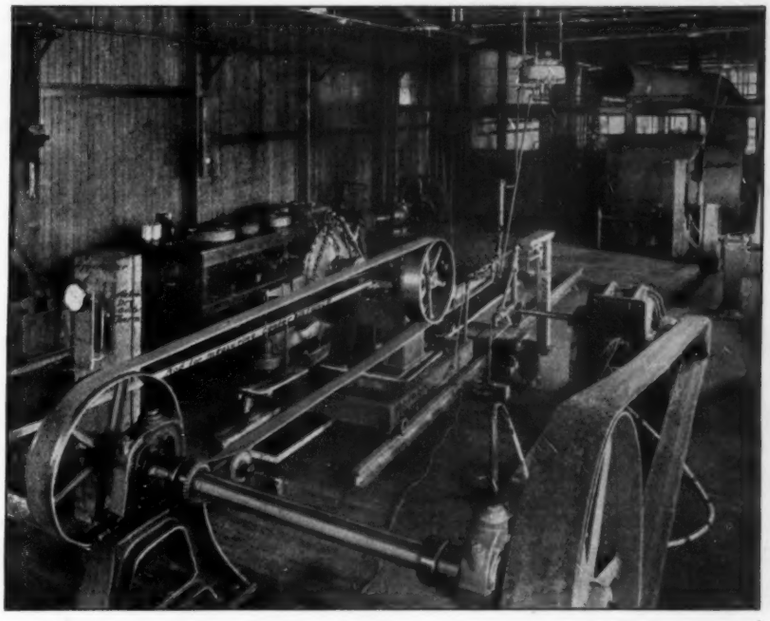


FIG. 1—GENERAL LAYOUT OF TESTING APPARATUS

In order to measure all of the power transmitted by the belt, the shaft bearings were so designed that they formed a part of the dynamometer. Fig. 4 shows this arrangement in more detail. The bearings consist of pairs of ball bearings in which the shaft turns. The ball bearings are carried in a housing which is free to turn inside of a pair of standard roller bearings. Thus what little friction there may be in the ball bearings will tend to turn the housing which is attached to the dynamometer casing and thereby becomes a part of it.

In the rear of the room, Fig. 1, is a Sturtevant heater and blower, the heater to keep the temperature under control and the blower to circulate the air in the room. A live steam jet inside of the heater and a humidifier hung from an overhead beam were used for humidity control. The use of the humidifier had to be discontinued because it was found to give fog instead of true humidity and consistent results could not be obtained while with the steam jet it was possible to duplicate results at any time. The degree if relative humidity was measured by a precision hygrometer of the hair type, a wet and dry bulb thermometer and a sling psychrometer, a modification of the pattern developed by the U. S. weather bureau, the last method giving very satisfactory results.

The belt used in this investigation was four-inch, single, oak tanned leather. The pulleys were a pair of cast iron crown face pulleys, 24 inches in diameter with a 6-inch face. The initial length of the belt was such that the center distance at 20 per cent humidity, $T_1 + T_2$ equalling 320 pounds, was 9 feet, 6 9/16 inches. This makes the belt approximately 25½ feet long.

Standard conditions were assumed to be $T_1 = 240$ or 60 pounds per inch of width, and $T_1 / T_2 = 3$, where $T_1 =$ the tension in the tight side of the belt and T_2 the tension in the slack side. This gives $T_1 - T_2 = 160$ pounds and as the belt speed remained constant at about 1,900 feet per minute, the horse-

Presented at the Buffalo meeting of the American Society of Mechanical Engineers, June 22-25.

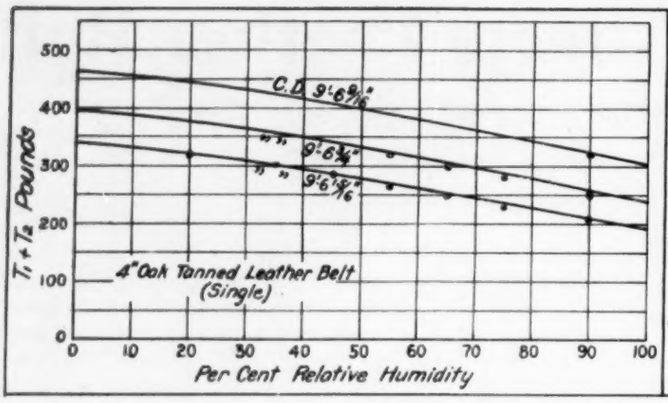


FIG. 2—RELATION BETWEEN $T_1 + T_2$ AND PER CENT RELATIVE HUMIDITY FOR THREE CONDITIONS OF CENTER DISTANCE, HORSEPOWER CONSTANT

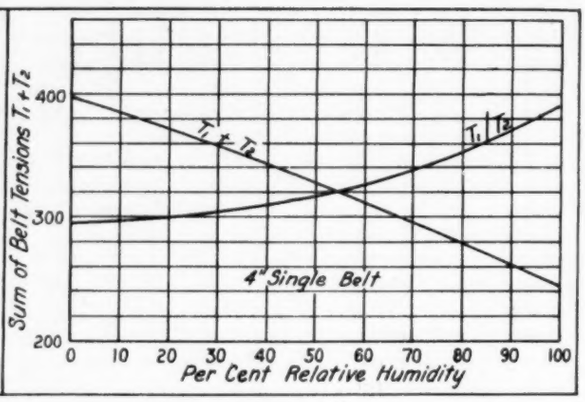


FIG. 3—EFFECT OF CHANGE OF HUMIDITY FROM 55 PER CENT, HORSEPOWER CONSTANT

power was approximately 9.21 at all times. This condition will give between 0.8 and 0.9 per cent slip, or creep.

The experiments were run to see if a difference in the modulus of elasticity of the belt, when running, could be detected at 20 per cent, 55 per cent and 90 per cent humidity. These relations as found are shown in Fig. 7. Tests were also made at these humidities to see if a difference in the slip due to different values of the modulus of elasticity could be shown. No noticeable effect could be detected.

The results of the tests under the second condition are shown for three different values of $T^1 + T^2$ in Fig. 9. The results of these two sets of experiments were investigated and plotted as a surface as shown in Fig. 10. From Fig. 10 the data for the curves of Fig. 2 were taken. After these curves were drawn, experiments were performed and the circles shown in Fig. 2 indicate the results obtained. These results, as will be seen were a very good check on the calculations.

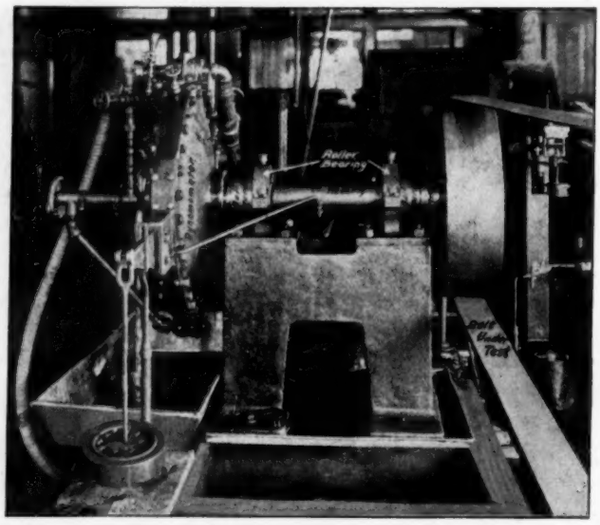


FIG. 4—DETAIL VIEW OF DYNAMOMETER

The three black spots indicated on the surface of Fig. 10 all occur at $T^1 + T^2 = 320$ pounds. Now starting at any one of these points and keeping the center distance constant, take the course indicated by the line along which the printing occurs. This line is seen to cross the lines of constant tension, the tension increasing as the relative humidity decreases, or vice versa.

The surface shown in Fig. 10 might well be called the characteristic of this belt, and it indicates in a general way what might be expected from similar belts. Leather itself will vary; the tanning is different; the quantity and quality of belt dressing is seldom twice the same. All of the factors being more or less unknown, it will be impossible to make definite

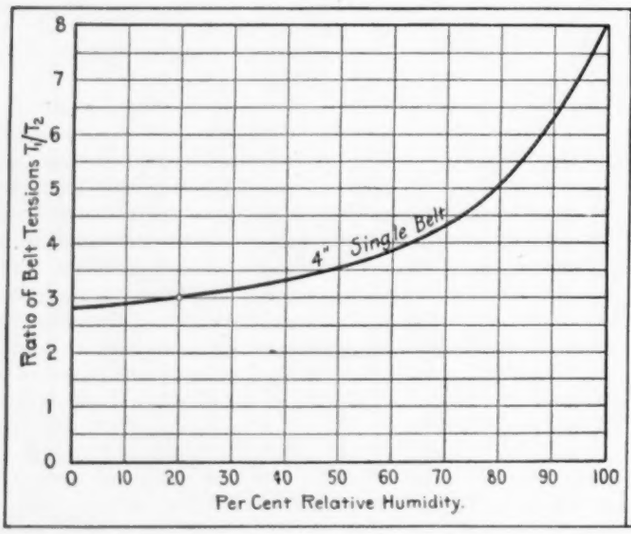


FIG. 5—EFFECT OF CHANGE OF HUMIDITY FROM 20 PER CENT, HORSEPOWER CONSTANT

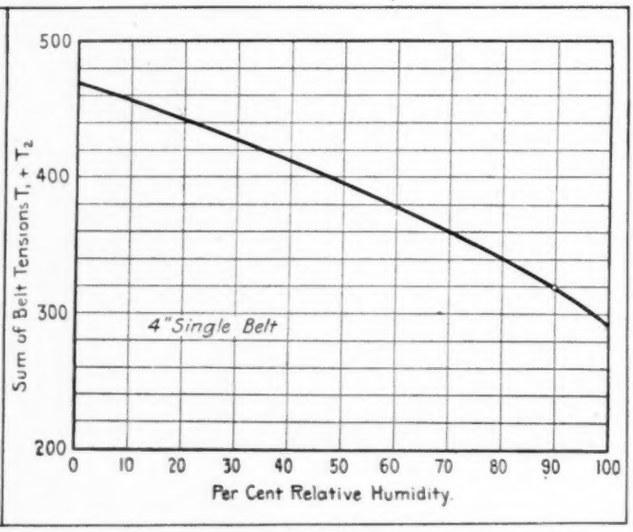


FIG. 6—EFFECT OF CHANGE OF HUMIDITY FROM 90 PER CENT, HORSEPOWER CONSTANT

prediction in reference to other belts. However, in a general way, it may be stated that the effect of a change in relative humidity is greater at high humidities than at low, that the effect is shown more rapidly in a single than in a double belt, and that increasing the humidity shows immediate results while a decrease in humidity takes some little time to be effective.

If a belt be set up at 20 per cent humidity under standard conditions, the load remaining constant, and the center distance being fixed, an increase in the humidity will decrease the sum of the tensions, while the difference of the tensions will remain the same since the load is constant. Therefore, the ratio of the tensions or T_1 / T_2 will increase with the humidity, and at about 90 per cent humidity the belt will be on the point of slipping. This varjation is shown in Fig. 5. The data for the curve is taken from Fig. 10.

If the belt be set up at 90 per cent relative humidity under standard conditions, a decrease in humidity will increase the sum of the tensions, provided the distance between centers remains constant. This will result in an excessive pressure on the bearings at low humidity and also tend to stretch the belt beyond the elastic limit. This is shown in Fig. 6 which is in reality a section of the surface in Fig. 10. If the standard set up be made at 55 per cent relative humidity, which is somewhere near the normal, any possible increase in relative humidity will not produce an excessive ratio of tensions, and any possible decrease in relative humidity will not cause an undue sum of tensions. Both of these relations are shown in Fig. 3.

As the higher relative humidities

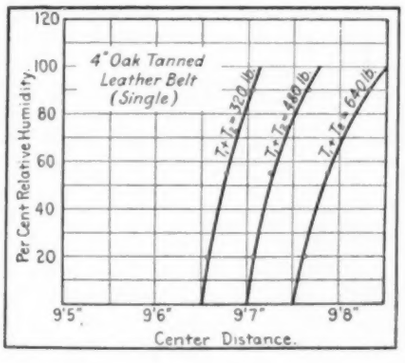


FIG. 9—RELATION BETWEEN PER CENT RELATIVE HUMIDITY AND CENTER DISTANCE AT THREE CONDITIONS OF $T_1 + T_2$, HORSEPOWER CONSTANT

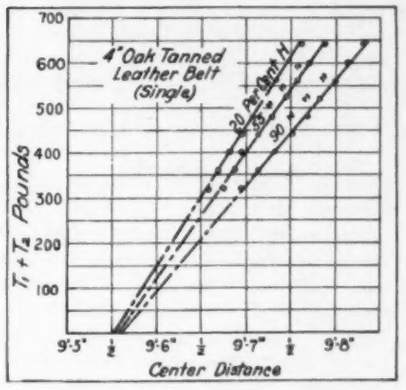


FIG. 7—RELATION BETWEEN $T_1 + T_2$ AND CENTER DISTANCE AT THREE CONDITIONS OF RELATIVE HUMIDITY, HORSEPOWER CONSTANT

generally occur at temperatures above 70 degrees it was thought best to extend the field of investigation by varying the temperature. Accordingly a series of experiments was run at 50 degrees temperature with the relative humidity varying from 20 to 90 per cent and another series at 90 degrees temperature, $T_1 + T_2$ and horsepower being constant for all of these tests.

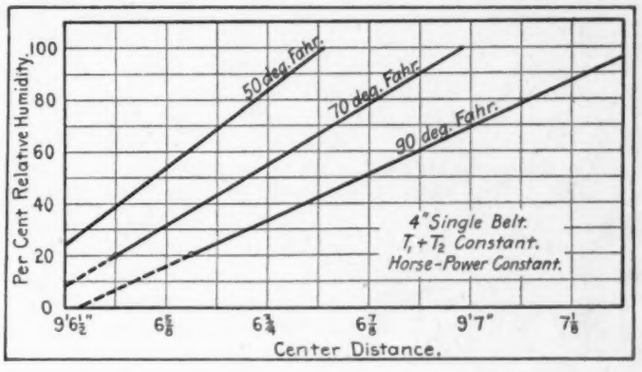


FIG. 8—RELATION BETWEEN CENTER DISTANCE AND RELATIVE HUMIDITY OF THREE DIFFERENT TEMPERATURES

These results are shown in Fig. 8, which also has the corresponding results at 70 degrees from previous experiments. This would indicate that the belt lengthens as the temperature increases, the relative humidity remaining constant; that the amount of this lengthening of the belt is somewhat greater at high relative humidities than at low relative humidities; and that the lengthening of the belt due to an increase in the relative humidity is greater at temperatures higher than 70 degrees and less for temperatures under 70 degrees.

It would appear from these experiments that the lengthening of the belt which takes place when the humidity increases, is very nearly proportional to the relative humidity while no definite relation to absolute humidity exists. The fact that the lines in Fig. 8 are not parallel would indicate that either there is some slight effect due to changes in the absolute humidity or, what is more probable, that the coefficient of expansion is greater at 90 degrees than at 20 degrees temperature.

The general conclusions are:

First—If a belt be set up at low relative humidity, slipping will probably occur if the relative humidity increases to any great extent, especially if accompanied by a rise in temperature.

Second—If a belt be set up at high relative humidity, excessive pressure on the bearings and stretching of the belt will result from a decided decrease in relative humidity, especially if accompanied by a fall in temperature.

Third—If a belt be set up at a medium relative humidity, the tensions will not be excessive at lower relative humidities, nor will there be any great danger of slipping at high relative humidities unless accompanied by excessive temperature changes. In other words, the factor of safety in the ordinary belt rules is sufficient to take care of the effect of changes in the relative humidity if the set up be made at a medium per cent of relative humidity.

Fourth—If a belt be set up at any relative humidity with a spring or gravity tightener, a load 50 per cent greater than the standard can be transmitted at either high or low humidity without encountering any danger of stretching the belt, of slipping or of any excessive pressure on the bearings.

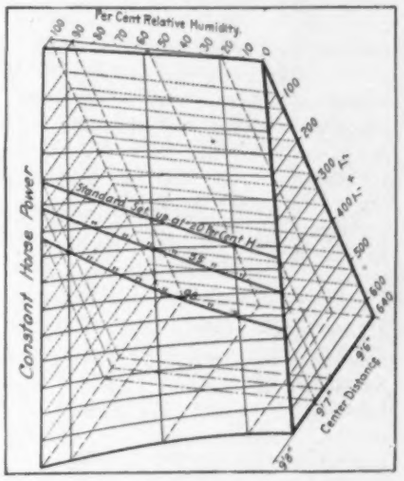


FIG. 10—BELT PERFORMANCE SURFACE SHOWING RELATION BETWEEN CENTER DISTANCE, SUM OF TENSIONS AND PER CENT RELATIVE HUMIDITY

Making Money From Furnace Slag

Description of a New Method of Handling and Marketing Blast Furnace Slag Using Twin Beds and a Patented Chain System

FROM the earliest beginnings of the manufacture of pig iron, the handling and disposal of the slag has been a serious problem. At many older plants there are huge banks of slag, like mountains of volcanic matter, which are now being dug up and crushed and sold for many purposes. In early days slag was handled in two ways.

At some plants it was run from the furnace into side or end dump ladle cars, or was tapped into cars with sloping sides, from which it was discharged by opening a hole in the side and draining out the liquid slag, afterward lifting the sides with a crane and tilting the bottom so the sculls would slide off. These cars, together with the side and end dumping ladles, were small, costly to operate and maintain, and often ran on narrow gage tracks.

Slag Led into Runners

The other method was to lead the slag into long parallel runners made by dragging a long-handled shovel backwards through the sand. When cooled, these runners, which were sometimes nearly 100 feet in length, were broken by pulling up with iron hooks and the pieces were forked into cars, and given to railroads to be used in constructing fills or as ballast.

The most radical early improvement in handling slag resulted from the wonderful mechanical development of quick-dumping ladles of large capacity running on standard gage tracks, but where land was too costly for dumps and the railroads would take the slag, the granulating pit finally came into use. In this case the molten slag is run into a pit of water, and frequently, also, the stream of slag is flushed by a heavy stream of water flowing in the same direction. The slag boils up into a light, fluffy mass and often separates as a very light sand, called granulated slag. With the railroads, who have been taking and dumping enormous quantities of this material, beginning to demand as high as 30 cents a ton for such wastage, this method loses its advantages and becomes a disadvantage, unless the granulated slag is used for the manufacture of Portland cement. In many localities this latter solution of the problem is impracticable.

Some years ago a plant was developed consisting of a set of beds, located high enough to discharge directly onto a railroad car. The slag was run into these beds from the furnace and allowed to cool in slabs 40 feet long and 8 feet wide, usually 4 to 6 inches thick. A plow, pulled by chains, slid the slab off the bed, where rotating hammers broke it into small pieces, discharging it onto a car. This worked well for a number of years.

The Croxton Method

A new method recently has been developed, called the Croxton patented chain system, controlled by D. T. Croxton, Rockefeller building, Cleveland. Under this plan twin slag beds, 30 x 40 feet or more in area, are provided. Across the bottom of one bed heavy chains are laid in parallel lines, about 30 inches apart, with the ends extending up out of the bed. At the convenience of the furnace operator, or as made, the slag is run over the chains, tending to level itself, and forming layers of varying thickness, depending on the quantity of the slag in each run and the size desired for the market. At the end of 24 hours or more one bed will be full, from 30 to 40 inches thick, in 2-inch or 3-inch layers. The crane which moves over the beds pulls out the chains, ripping them up through the slag, thereby breaking it up like ordinary soft coal, with very few large lumps.

FIG. 1—RIPPING UP SLAG BED WITH CHAIN SUSPENDED FROM HOOK OF TRAVELING CRANE

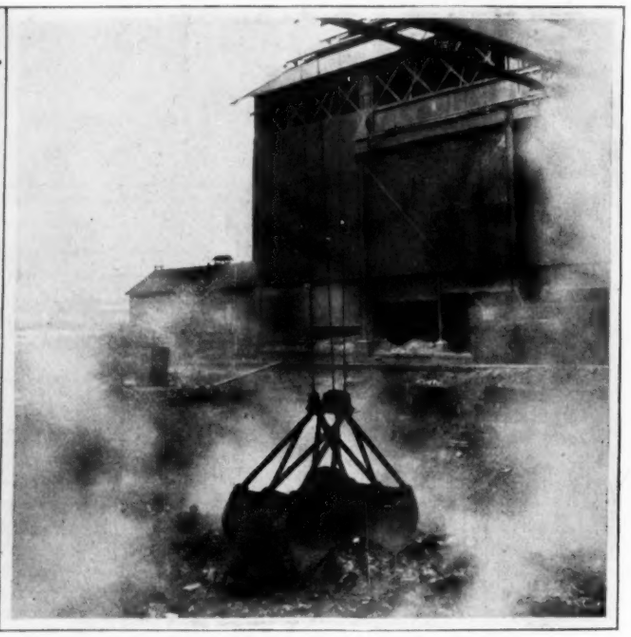


FIG. 2—TRANSFERRING BROKEN SLAG TO CARS WITH GRAB BUCKET

The chains then are laid on the bottom of the other bed, into which slag is run for the next 24 hours, while a grab bucket on the crane digs out the broken slag in bed No. 1 and conveys it to a car or puts it directly into a crusher, where it is crushed, screened and delivered to bins, properly sized for the market.

But little labor is required, as even our large furnaces produce little more than 200 tons of slag, per day, and a 2-ton bucket making one trip per minute requires only 100 minutes, or one hour and 40 minutes, to load 24-hours' product onto a car. There is a minimum of steam and dirt flying around the plant; a large reduction in railroad switching cost in slag handling is claimed, and also, in almost any locality, the slag is marketable. It is said that in these days of concrete construction and road building, a furnace located in reasonably well populated district can make from $10,000 to $30,000 per year from its slag. It is now accepted as an aggregate for concrete by most engineers and in city building codes.

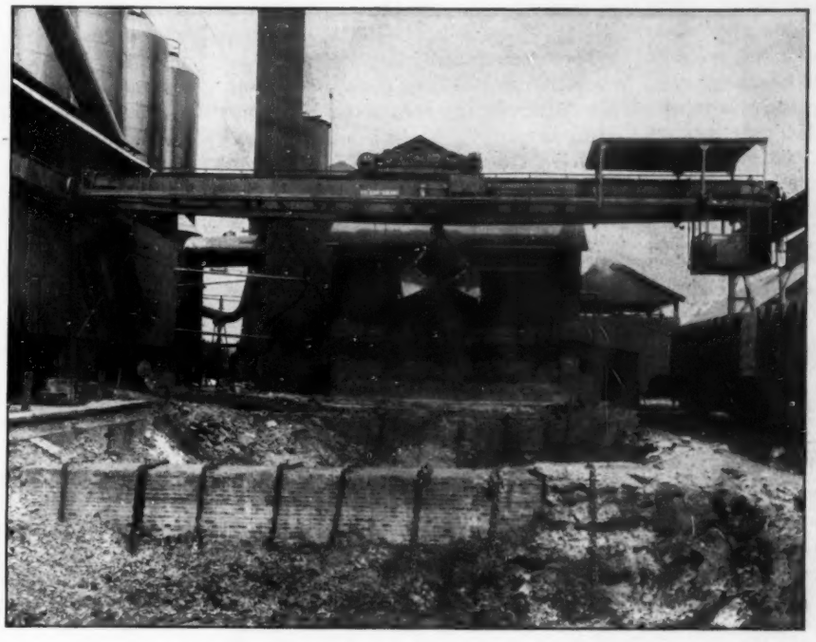


FIG. 3—CRANE LAYING CHAINS IN SLAG BED

The value of slag in road building, driveways, macadamizing, railroad work, etc., is well established. Country roads of concrete are now being constructed and slag concrete is a favored material. Where a brick surface is desired, some engineers are using 10 per cent of slag concrete for the foundation. In fire-proofing floors, etc., slag sand or screenings and slag concrete are also of value. Slag is also used as a roofing gravel, and for many other purposes.

With a proper plant for crushing, screening and sizing, combined with the Croxton chain system and hammer mills, slag in all sizes, including sand or powder for cement-making, can be produced at a low cost. It is also said that 2.5 per cent iron can be recovered by passing this material over a magnetic separator after it is crushed.

Joseph Battles has been appointed district sales manager for the Terry Steam Turbine Co., Hartford, Conn., covering the states of New Mexico, Colorado, Wyoming and the western portion of Nebraska. Mr. Battles' headquarters will be at 326 First National Bank building, Denver.

Large Pump Contract

The contract for a complete pumping plant for dry dock No. 1, Balboa, Panama, has been awarded to Henry R. Worthington, New York City. The plant comprises four main pumps, two drainage pumps and one bilge pump. Delivery must be made in 210 days.

The four main pumping units are identical in all parts. Each consists of a 54-inch centrifugal pump, with a minimum capacity of 11,000 cubic feet of sea water per minute, against varying static heads ranging from zero to 48 feet, and operating at 250 revolutions per minute. Each unit is directly connected to a 1,000 horsepower squirrel cage, induction type motor.

The average overall efficiency, or the ratio of the pump input to the work done by each unit in pumping against the total heads encountered, is guaranteed to be not less than 64.5 per cent.

The two drainage pump units are likewise identical in all parts. Each consists of a 20-inch centrifugal pump with a minimum capacity of 1,200 cubic feet of sea water per minute, against the range of heads encountered, and operating at a speed of 750 revolutions per minute. Each unit is driven by a 200 horsepower motor, provided with automatic control. The average overall efficiency for each unit is guaranteed to be not less than 64 per cent.

The bilge pump unit is of the vertical self-contained centrifugal type, having 4-inch suction and 3-inch discharge, with a capacity of 25 cubic feet of sea water per minute against any stage of the tide. The unit is directly connected to a 10-horsepower motor operating at 1,500 revolutions per minute. The motor is provided with both hand and automatic control. The overall efficiency for this unit is guaranteed to be not less than 32 per cent.

The contract further includes all of the hand and power operated gate valves as well as the automatic check valves. For operating the gate and sluice valves by power, a hydraulic pressure system is provided. This consists of a weighted accumulator and the necessary pressure pumps in duplicate. All power operated valves are controlled from a control board.

Galvanizing Standards

(*Continued from page* 1310)

side only, when in reality this amount of coating represents 2 square feet of surface. After immersing the entire length of wire for one minute it will be found convenient to pour the acid solution into another tall cylinder in order to facilitate removing the wire. The wire is then scrubbed under running water, wiped, thoroughly dried in a warm place for a few seconds and again weighed. Each gram lost corresponds to one ounce of coating per square foot. For direct comparison with the weight of coating as expressed on galvanized sheets, this figure should be doubled.

The General Electric Co., Schenectady, N. Y., in a recent bulletin illustrates and describes its line of hand-operated starting rheostats and panels for direct current motors. These devices range in capacity from ⅛ to 500 horsepower and are designed for use on 115, 230 and 550 volt direct current circuits.

It is the little accidents, day by day, that make the fearful total of American casualties. It is not the catastrophies you read about in the paper. And most of these little accidents are avoidable.

Progress in Blast Furnace Practice

Results of an Efficiency Test on Hot Blast Stoves—Use of Hot and Dry Blast—Future Development of Blast Furnaces

BY A. E. MACCOUN

THE ECONOMICAL importance of reducing the ores in a blast furnace, principally by carbon monoxide (CO), is well understood by operators, as reduction effected by carbon at the tuyeres is uneconomical, requires a great quantity of heat and abstracts this heat from a point in the furnace where it is most needed. This is avoided to some degree by proper furnace lines, good distribution and uniform operating conditions. Any tendency to consume coke in the upper part of the furnace also should be avoided, because less coke will remain for combustion at the tuyeres where the greatest heat is needed. Soft coke or coke dust is more readily affected by carbon dioxide (CO_2) than hard coke, this fact resulting in this loss. In the lower part of a blast furnace, carbon is only oxidized to carbon monoxide (CO), which generates 4,375 B. T. U. per pound of carbon, but when complete combustion takes place to carbon dioxide (CO_2), 14,580 B. T. U. are generated. Therefore the heat generated by a unit of carbon in heating the blast is 333 per cent as great as that generated by a unit of carbon burned in the furnace.

Fourth and last installment of a paper read at the New York meeting of the American Iron and Steel Institute, May 28. The author, A. E. Maccoun, is superintendent, Edgar Thomson furnaces, Carnegie Steel Co.

Advantages of Hot Blast

The use of hot blast increases the temperature and efficiency of combustion near the tuyeres of a blast furnace, causes the carbon to be quickly converted into carbon monoxide, and localizes the heat of combustion. Heat supplied to the furnace by the more complete burning of carbon outside the hearth in the stove allows the amount of coke charged to be greatly decreased, consequently a smaller quantity of blast is required, the upper part of the furnace is cooler, radiation losses are lessened, and less sensible heat is carried away in the escaping gases.

One of the greatest advantages of hot blast consists also in the intense local heat produced in the hearth, this intensity controlling to a great extent the rate of heat transfer to the descending materials, and the efficiency and speed of the smelting. This matter of local heat intensity is of great interest, as it accounts for savings due to high blast heats that could not otherwise be explained on the basis of actual heat units added to the hearth by the preheated blast.

As a result of the diminished amount of fuel required by the use of high heats, a smaller quantity of slag is yielded from its ash, less limestone is required for fluxing, a fur-

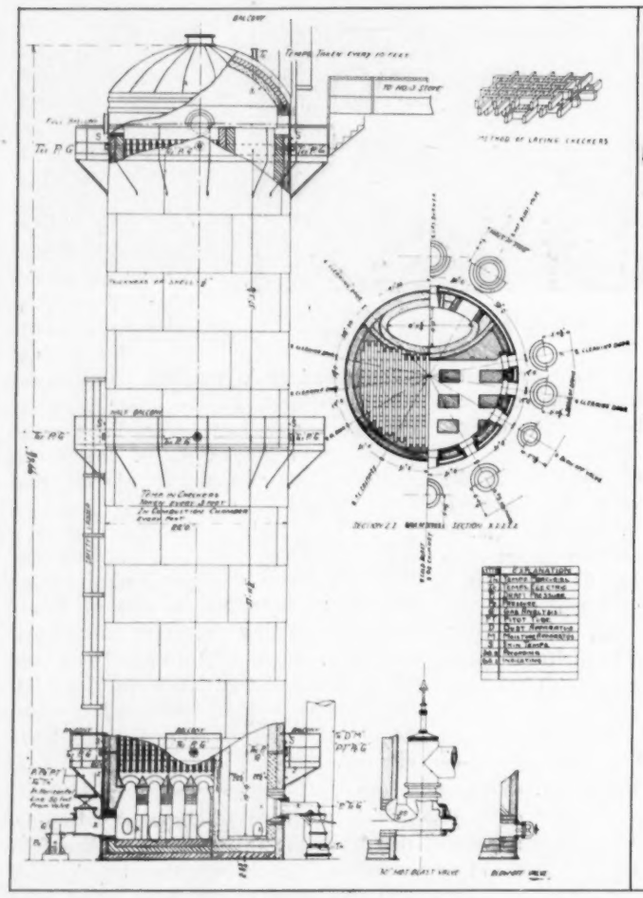


FIG. 5—GENERAL ARRANGEMENT OF HOT BLAST STOVE ON WHICH TEST WAS RUN

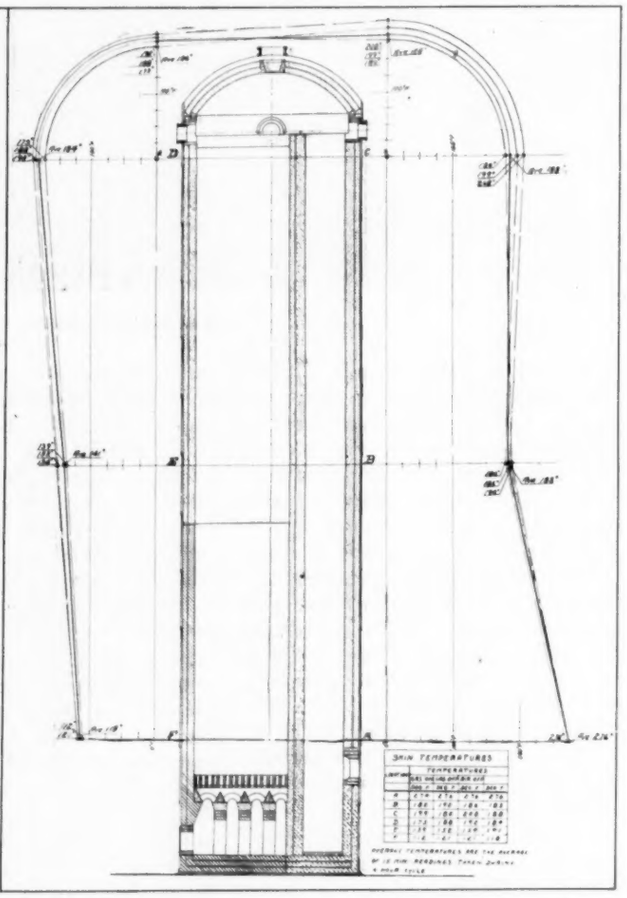


FIG. 6—RESULTS OF TEST TO DETERMINE SKIN TEMPERATURES

nace of a given capacity contains more ore and its production is therefore increased.

In this country at the present time every blast furnace manager is trying to obtain all the advantages possible, such as better quality of product, lower cost of production and a larger tonnage, by the use of high heats, but there is a limit as to how far this can be economically carried out.

With some furnaces having bad distribution or badly worn lines it is impossible to make use of high heats, such as 1,200 or 1,300 degrees Fahr., and obtain these greater economies, but with good distribution and well proportioned furnace lines in good condition, these heats can be easily carried most of the time and the economies effected. However, it is essential that operating conditions be kept as uniform as possible. Any irregularity in volume, pressure or temperature of blast has decided effects on the maximum degree of heat it is possible to carry subsequently on any given furnace, and still maintain smooth working.

One of the savings due to higher heats comes from the ability to carry more acid slags. The temperature at the tuyeres is more efficient in the removal of sulphur, and because of the lower coke consumption there is less sulphur to remove. The ability to run more acid is a great benefit to successful blast furnace operation, as with basic slags lime gradually collects on the bosh, causing scaffolds and frequent cleaning-offs and resulting in poor furnace operation. Of course, the ability to run on acid slags depends to a certain extent on the sulphur in the burden and the cinder volume being carried.

Volume of Blast Furnace Gas

There is a definite amount of fuel gas passing off from a blast furnace, corresponding to its fuel consumption, which has a definite fuel value. This gaseous fuel has a much greater commercial value than an amount of coal containing an equal number of B. T. U., as it does not require handling expense, and is an ideal fuel for boilers or gas engines.

On this account, this fuel should be burned very economically in the stoves in order to conserve as much as possible from the balance of gas left over for other useful purposes. For this reason, furnace operators are giving considerable attention to the design of the most economical stove possible to fulfill these conditions.

There are many types of stoves, such as the two-pass, three-pass and four-pass, which give excellent results when well constructed. In regard to stoves, the problem is to get as simple a stove as possible, having the required strength, with the greatest amount of well arranged heating surface, so that all the heat possible will be absorbed from the passage of the burnt gases through the checkers, and this heat readily given up to the air during its passage through the stove. To better obtain these results, the tendency is to decrease the size of checker openings, and most of the newer stoves have from 5-inch to 6-inch checker openings in place of the customary 9-inch openings.

In the design of a stove, checker walls should be as thin as is consistent with structural strength, and the size of checker openings should be as small as operating conditions will permit. The surface of the stove brick exposed to the passage of the heated gases is of primary importance in a stove, and the thickness of walls and size of checker openings should be reduced to a minimum, considering the structural strength of brickwork required in any stove design and the ability to clean the checker openings.

Test of Hot Blast Stove

A modern blast furnace equipped with four well designed stoves, 22 feet in diameter, 100 feet high and having 60,000 square feet of heating surface each, should have no trouble in running on a straight line heat of 1,200 degrees Fahr. and still have plenty of reserve in case it is demanded by the furnace. The average stack temperatures from such stoves should be below 400 degrees Fahr. It should not be necessary to install five stoves in place of four if washed gas is used.

In an efficiency test on a 22 x 100-foot hot blast stove, the primary aim was to obtain data on which to base future improvements, either in construction or operation, so as to obtain increased heat efficiencies and, if possible, a decreased equipment; to obtain data on the comparative efficiency of this type with the older stoves in use; and to ascertain accurately the quantity of gas being consumed in the stoves. The test was run over a long period in order to compare with former stove tests made on short runs.

The stove is an improved two-pass Cowper type. The outside diameter of the shell is 22 feet and the height over all 100 feet. The gas burner is the Spearman type. The hot blast nipple and water-cooled hot blast valve used were also of standard type and size. The general arrangement of the stove is shown in Fig. 5. The combustion chamber is roughly elliptical in shape, 10 feet, 11¾ inches on the major axis, and 4 feet, 11 inches on the minor axis. It rises vertically to the dome of the stove and has an area of approximately 42 square feet. The gas enters on the minor axis of the combustion chamber, this axis being placed radially from the center of the stove. The combustion chamber is separated from the checker chamber by a 22½-inch fire brick partition, which rises 18 inches above the top of the checkers to form the bridgewall.

The checker chamber which fills the remaining space below the dome is filled with 15 x 7½ x 3-inch checker brick laid as shown in the illustration. The stove is provided with three standard chimney valves having openings 20½ inches in diameter, two of which open directly into the shell, the third opening into a cast iron tee. The cold blast enters through this tee and is supplied by a 2.99-foot inside diameter cold blast line. This stove is a modern type, its efficiency being approximately 60 per cent. The results of the test have furnished information that will aid in obtaining still higher efficiency from hot blast stoves in the future. The use of clean gas is a great aid in this direction, as it was impossible to attempt these improvements when dirty gas was being used on stoves.

Description of Apparatus

During the erection of the stove, holes were drilled through the shell and brick work at three levels, 18 inches above bottom of checkers, at center level of checkers, and 18 inches below top of checkers. Holes also were drilled through the dome above the center of the combustion chamber. These holes were provided with flanges having 4-inch openings. A 4-inch diameter hole was cut in the shell under each flange, and a 1½-inch diameter hole through the brick work.

One hole opened through the dome directly above the center of the combustion chamber. Three holes opened into the combustion chamber through the sides and were cut radially on the minor axis of the combustion chamber. Three holes opened into the checker chamber diametrically opposite the holes in the combustion chamber and three more were cut into the checker chamber on the diameter, 90 degrees from the other holes. The center lines of all the holes passed through the center line of the stove. The checker brick opposite the holes

Table XVII.

RESULTS OF AN EFFICIENCY TEST ON HOT BLAST STOVE

			1	2	3	4
(1)	Number of test					
(2)	Date of test		Sept. 15-21, 1913	Oct. 28 to Nov. 1, 1913	Nov. 3 to Nov. 9, 1913	Nov. 10 to Nov. 16, 1913
(3)	Blast furnace and stove number		"G" No. 4	"G" No. 4	"G" No. 4	"G" No. 4
(4)	Size of stove		22 x 100 ft.	22 x 100 ft.	22 x 100 ft.	22 x 100 ft.
(5)	Type		Two-Pass	Two-Pass	Two-Pass	Two-Pass
(6)	Heating surface in checkers	Sq. ft.	51,192	51,192	51,192	51,192
(7)	Cubic contents in checkers	Cu. ft.	8,894	8,894	8,894	8,894
(8)	Ratio of heating surface to cubic contents of brickwork in checkers		5.75:1	5.75:1	5.75:1	5.75:1
(9)	Estimated weight of brickwork in stove	Lbs.	3,617,000	3,617,000	3,617,000	3,617,000
(10)	Estimated weight of iron in stove	Lbs.	223,000	223,000	223,000	223,000
	Pressures.					
(11)	Blast furnace gas in main	Ins. H_2O	3.46	2.70	2.60	2.85
(12)	Draft in combustion chamber	Ins. H_2O	....	0.72	1.25	0.92
(13)	Draft in chimney No. 1	Ins. H_2O	1.38	1.51	1.45	1.48
(14)	Draft in chimney No. 2	Ins. H_2O	Not on	Not on	1.50	Not on
(15)	Draft in chimney No. 3	Ins. H_2O	1.40	1.66	1.54	1.56
(16)	Average draft at chimneys	Ins. H_2O	1.39	1.58	1.47	1.52
(17)	Blast in main	Lbs. per sq. in.	13.45	14.87	16.90	16.84
(18)	Barometer at 32 degrees Fahr.	Ins. Hg.	29.500	29.380	29.239	29.280
	Areas.					
(19)	Burner opening	Sq. ins.	165.29	165.29	165.29	165.29
(20)	Area of gas leg	Sq. ins.	1,366.36	1,366.36	1,366.36	1,366.36
	Temperatures.					
(21)	Blast furnace gas in main	Deg. Fahr.	85.52	63.21	67.42	57.94
(22)	Cold blast in main	Deg. Fahr.	178.0	163.5	172.5	160.5
(23)	Hot blast in main	Deg. Fahr.	1,356.0	1,218.0	1,183.0	1,200.0
(24)	Gases No. 1 chimney (min.)	Deg. Fahr.	390.0	459.0	437.0	391.0
(25)	Gases No. 1 chimney (max.)	Deg. Fahr.	600.0	612.0	590.0	589.0
(26)	Gases No. 1 chimney (ave.)	Deg. Fahr.	519.0	563.0	540.0	537.0
(27)	Gases No. 2 chimney (min.)	Deg. Fahr.	Not on	Not on	395.0	Not on
(28)	Gases No. 2 chimney (max.)	Deg. Fahr.	Not on	Not on	695.0	Not on
(29)	Gases No. 2 chimney (ave.)	Deg. Fahr.	Not on	Not on	545.0	Not on
(30)	Gases No. 3 chimney (min.)	Deg. Fahr.	400.0	374.0	403.0	360.0
(31)	Gases No. 3 chimney (max.)	Deg. Fahr.	640.0	531.0	570.0	596.0
(32)	Gases No. 3 chimney (ave.)	Deg. Fahr.	536.0	488.0	515.0	538.0
(33)	Chimney gases, total ave	Deg. Fahr.	527.5	526.0	533.0	537.5
(34)	Atmosphere, wet bulb	Deg. Fahr.	63.71	44.43	50.26	42.17
(35)	Atmosphere, dry bulb	Deg. Fahr.	69.08	47.73	55.48	44.84
	Duration.					
(36)	Time stove on gas	Hours	95,481	72.488	98.064	100.398
(37)	Time stove on blast	Hours	35.771	27.145	34.949	35.080
(38)	Total elapsed time for test	Hours	136.100	103.908	140.000	140.633
	Gas.					
(39)	Heat value per cu. ft. of dry gas at 62 deg. Fahr. and 30 in. Hg. (gross)	B. T. U.	94.63	93.03	88.51	95.11
(40)	Grains of moisture per cu. ft. at 62 deg. Fahr. and 30 in. Hg		7.410	5.69	5.55	4.86
(41)	Grains moist. per cu. ft. as act'ly exist. in main	Grains	7.03	5.59	5.41	4.87
(42)	Total gas consumed at condition in main	Cu. ft.	28,701,589	25,139,665	31,341,274	30,528,654
(43)	Total gas cons'd at 62 deg. Fahr. and 30 in. Hg.	Cu. ft.	27,237,808	24,687,151	30,604,754	30,623,293
(44)	Gas consumed per min. at temp. and pressure in main	Cu. ft.	5,010	5,780	5,326	5,069
(45)	Gas consumed per min. at 62 deg. Fahr. and 30 in. Hg.	Cu. ft.	4,754	5,676	5,201	5,084
(46)	Total moist. in gas consumed	Lbs.	30,395	20,061	24,227	21,248
(47)	Grains of dust per cu. ft. at 62 deg. Fahr. and 30 in. Hg	Grains	0.0719	0.0811	0.1385	0.1876
(48)	Grains of dust per cu. ft. as act. exist. in main.	Grains	0.0682	0.0802	0.1352	0.1882
(49)	Total dust in gas consumed	Lbs.	156.52	286.02	605.50	814.02
	Blast.					
(50)	Total air blown at condition in main	Cu. ft.	42,959,540	36,754,254	46,590,295	45,920,948
(51)	Total air blown at 62 deg. Fahr. and 30 in. Hg.	Cu. ft.	65,964,374	59,714,636	31,854,489	79,443,240
(52)	Total air blown per min. at 62 deg. Fahr. and 30 in. Hg	Cu. ft.	30,735	36,664	39,035	37,744
(53)	Grains of moist. per cu. ft. at conditions in main	Grains	9.03	4.83	6.27	5.23
(54)	Total dry air heated	Lbs.	5,030,347	4,611,814	6,150,198	6,162,178
(55)	Total moisture heated	Lbs.	36,086	25,397	41,745	34,303
	Atmosphere.					
(56)	Grains of moist. per cu. ft.	Grains	5.8800	2.9754	3.5408	2.9654
(57)	Humidity	Per cent	76.10	75.50	70.20	79.93
(58)	Total dry air entering stove for combustion	Lbs.	2,301,734	2,479,571	2,868,633	2,834,483
(59)	Total moist. entering stove with air for combus.	Lbs.	16,399	13,869	19,480	15,757
	Total Quantities.					
(60)	Total weight of dry gas consumed	Lbs.	2,043,553	1,840,827	2,309,350	2,290,046
(61)	Total weight of dry air for combustion	Lbs.	2,301,734	2,479,571	2,868,633	2,834,483
(62)	Total wgt. of moist. enter'g stove during combus.	Lbs.	46,794	33,930	43,707	37,005
(63)	Total weight of moist. generated by combustion.	Lbs.	50,004	48,240	56,151	64,449
(64)	Total weight of dry air heated for blast	Lbs.	5,030,347	4,611,814	6,150,198	6,162,178
(65)	Total weight of moist. heated for blast	Lbs.	36,086	25,397	41,745	34,303
(66)	Total weight of gas through stack	Lbs.	4,442,085	4,402,568	5,277,841	5,225,983
(67)	Total weight of blast	Lbs.	5,066,433	4,637,211	6,191,943	6,196,481
	Efficiency.					
(68)	Total heat absorbed by blast	B. T. U.	1,417,521,450	1,264,629,900	1,618,537,227	1,664,227,221
(69)	Total heat generated (corrected for sensible heat in gas above 62 deg. Fahr.)	B. T. U.	2,517,129,355	2,234,916,219	2,662,441,226	2,867,251,184
(70)	Efficiency	Per cent	56.32	56.59	60.79	58.04
	Heat Balance.					
(71)	Total heat absorbed by blast	B. T. U.	1,417,521,450	1,264,629,900	1,618,537,227	1,664,227,221
(72)	Loss of heat to dry chimney gases	B. T. U.	487,848,410	484,272,391	584,433,439	582,916,975
(73)	Loss of heat to incomplete combustion	B. T. U.	.....	.....	.....	.....
(74)	Loss of heat to moisture in air and gas	B. T. U.	10,574,040	7,639,679	10,005,844	8,561,107
(75)	Loss of heat to moisture from hydrogen	B. T. U.	63,693,595	61,407,590	71,689,666	82,439,938
(76)	Loss of heat to radiation	B. T. U.	261,638,640	199,752,739	269,136,000	270,352,879
(77)	Loss of heat unaccounted for, due to stove changes, etc.	B. T. U.	275,853,220	217,213,920	108,639,050	258,753,064
(78)	Total heat absorbed by blast	Per cent	56.32	56.58	60.79	58.04
(79)	Loss of heat to dry chimney gases	Per cent	19.38	21.67	21.95	20.33
(80)	Loss of heat to incomplete combustion	Per cent	.....	.....	.....	.....
(81)	Loss of heat to moisture in air and gas	Per cent	0.42	0.34	0.38	0.30
(82)	Loss of heat to moisture from hydrogen	Per cent	2.53	2.75	2.69	2.88
(83)	Loss of heat to radiation	Per cent	10.39	8.94	10.11	9.43
(84)	Loss of heat unaccounted for, due to stove changes, etc.	Per cent	10.96	9.72	4.08	9.02

Table XVII. (Continued)

	Thermal Output.					
(85)	Total elapsed time for test from time stove was taken off furnace at start to end of test.....	Hours	136.100	103.908	140.000	140.633
(86)	Average B. T. U. absorbed by blast per hour while stove was on furnace.....	B. T. U.....	39,627,672	46,587,950	46,311,403	47,440,913
(87)	Average B. T. U. absorbed by blast per hour for elapsed time of test.....	B. T. U.....	10,415,294	12,170,669	11,560,980	11,833,831
	Fuel Gas Analysis.					
(88)	CO_2	Per cent volume..	13.31	13.15	13.12	11.94
(89)	CO	Per cent volume..	25.22	24.54	23.38	24.84
(90)	O_2	Per cent volume..	0.28	0.38	0.46	0.52
(91)	H_2	Per cent volume..	3.91	4.11	3.88	4.45
(92)	N_2	Per cent volume..	57.28	57.82	59.16	59.25
	Stack Gas Analysis.					
(93)	Stack No. 1, CO_2	Per cent volume..	19.91	17.76	18.16	18.15
(94)	Stack No. 1, CO	Per cent volume..	Nil	Nil	Nil	Nil
(95)	Stack No. 1, O_2	Per cent volume..	3.99	5.67	5.18	4.70
(96)	Stack No. 1, H_2	Per cent volume..	Nil	Nil	Nil	Nil
(97)	Stack No. 1, N_2	Per cent volume..	76.08	76.57	76.66	77.15
(98)	Stack No. 2, CO_2	Per cent volume..	.....	.....	16.95	.....
(99)	Stack No. 2, CO	Per cent volume..	.....	.....	Nil	.....
(100)	Stack No. 2, O_2	Per cent volume..	.....	.....	5.72	.....
(101)	Stack No. 2, H_2	Per cent volume..	.....	.....	Nil	.....
(102)	Stack No. 2, N_2	Per cent volume..	.....	.....	77.33	.....
(103)	Stack No. 3, CO_2	Per cent volume..	19.92	17.50	17.88	18.01
(104)	Stack No. 3, CO	Per cent volume..	Nil	Nil	Nil	Nil
(105)	Stack No. 3, O_2	Per cent volume..	3.91	5.63	5.14	5.17
(106)	Stack No. 3, H_2	Per cent volume..	Nil	Nil	Nil	Nil
(107)	Stack No. 3, N_2	Per cent volume..	76.17	76.87	76.98	76.82
	Average Stack Analysis.					
(108)	CO_2	.....	19.92	17.63	17.66	18.08
(109)	CO	.....	Nil	Nil	Nil	Nil
(110)	O_2	.....	3.95	5.65	5.34	4.93
(111)	H_2	.....	Nil	Nil	Nil	Nil
(112)	N_2	.....	76.13	76.62	77.00	76.99

communicating with the checker chambers were drilled, having 1½-inch diameter holes through them. These openings formed continuous passages from the shell to the diametrically opposite brick walls, giving six passages through the checkers on 90-degree diameters, and four openings into the combustion chamber. The location of the holes is shown in Fig. 5. Balconies and platform with the necessary approaches were erected at the required levels. The gas main, cold blast line, hot blast nipple, chimney valves and burner base were provided with the necessary holes for admitting the following apparatus:

Recording pressure gages to read the pressure of the cold blast entering stove, fuel gas entering stove, draft in chimney valves and draft in the combustion chamber at the gas burner.

Recording thermometers to give the temperature of the fuel gas in mains, and the cold blast.

Recording pyrometers to give the temperatures of the stack gases at the chimney valves.

Recording differential gages connected to double bent pitot tubes in the gas main, and the cold blast line, to give the quantities of fuel gas and blast used.

A calibrated indicating pressure gage connected to the cold blast line.

Ellison multiplying gages to give the pressures in the gas main, draft in chimney valves, draft in the combustion chamber and for checking purposes.

Calibrated indicating pyrometers to give the temperatures of the hot blast, of the gases at various points in the combustion chamber and checkers, and at the chimney valves.

Calibrated mercurial thermometers to give the temperature of the gas in the mains, the cold blast, dry and wet bulb air temperatures, and for checking and correcting meter readings, etc.

Calibrated mercurial thermometers to obtain the skin temperatures of the stove.

Ellison multiplying differential gages to check the pitot tube pressures.

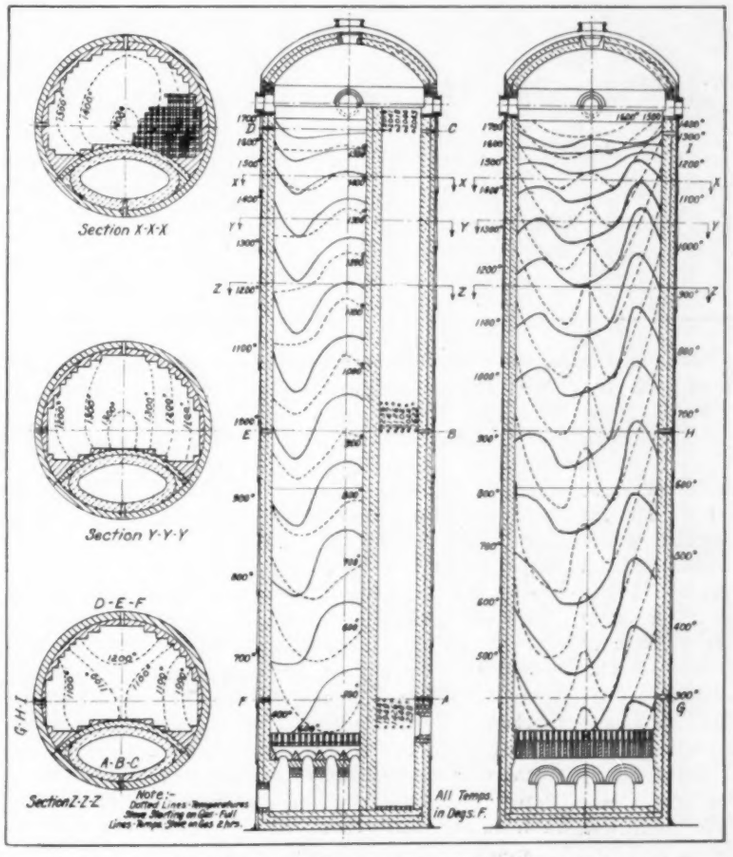


FIG. 7—RESULTS OF TESTS TO DETERMINE CHECKER TEMPERATURES

Continuous and snap gas samples were taken over acidulated water contained in two five-gallon glass carboys connected to form an aspirator. Samples were taken at the gas main, chimney valves, in the checkers and in the combustion chambers. The samples were transferred from the carboys to 200 cubic centimeter metal sample cans and analyzed. Dust and moisture determinations were made at stated intervals, the United States Steel Corporation standard apparatus being used in making these determinations. In Fig. 5 is shown the location of the various points at which readings were taken.

In running the tests all recording instruments were started on Monday morning and the necessary check readings taken on all instruments. If conditions were favorable, the test was started the first time the stove was taken off the furnace, and the final hot blast temperature noted. The test then was run continuously regardless of furnace or blast conditions until the following Saturday or Sunday morning. The test was stopped when a balancing point, that

is, the same hot blast temperature, was reached.

The recording instruments were maintained in continuous service throughout the run, charts being changed every 24 hours. Check readings on the indicating instruments were taken every 20 minutes and the recording instruments corrected if necessary. Fuel gas samples were started about 10 minutes after the gas was ignited and a continuous sample taken up to within five to 10 minutes before withdrawing the burner. Continuous chimney gas samples were taken at the same time from each chimney valve in service. These continuous samples were taken every time the stove was on gas. Dust and moisture determinations were made on the fuel gas, once each time the stove was on gas. During the time the stove was on blast, check readings on all air instruments were taken every 20 minutes and temperature readings of the hot blast were taken with an indicating pyrometer every minute for the first 10 minutes and every five minutes thereafter. These readings were checked at intervals by placing another complete pyrometer in parallel and reading both instruments at the same time.

In Table XVII is a tabulation of the results of four six-day tests. The usual methods of calculation were used with the exception of the calculation for radiation. This item was determined from the formula B. T. U. per minute = 0.03 × temperature difference inside and outside of wall × height of stove × [(diameter of stove — thickness of wall) ÷ thickness of wall.] The original data was taken from the charts by averaging the records obtained, and used after making all corrections. The tests include time lost for changing tuyeres, cleaning stoves, casting, checking, etc. The cold blast mixing valve was open more or less during all the tests. Tests 1, 2 and 4 were run on two-stack valves and test 3 with three-stack valves.

It should be remembered that these tests are under actual working conditions and include all of the above mentioned disturbing factors in distinction from previous short tests made under better conditions. These tests show a stove efficiency of from 56.32 to 60.79 per cent.

Comparing tests 1, 2 and 4 with a range of from 30,735 to 37,744 cubic feet of air per minute, using two chimney valves, with test 3 with 39,035 cubic feet of air per minute, using three chimney valves, it is found that the latter shows a gain of 2.75 per cent in efficiency over the best test on two valves and a saving of approximately 5 per cent in undetermined losses. These losses cover stove changes, cooling water, loss of gas, etc. During the runs with two valves, there was a continual escape of flame from the stove to the atmosphere around the burner. This was entirely stopped when running with three valves. The test with three valves shows a slight increase in the rate of flow of gases passing through the stove, namely 5,277,841 pounds in 98.064 hours, or 53,820 pounds per hour against an average of 53,103 pounds per hour for the test with two valves. This difference of flow should have been larger, but the gas pressure and heat value of the gas was slightly lower during this run and in spite of the increased draft in the combustion chamber, the total stack gas did not show a sufficient increase to determine the effect of an increased velocity on the efficiency.

Items 66 and 67, and 36 and 37 in Table XVII show weights of gas and blast through stove and the time during which these weights passed through the stove. These show an average flow of gas of 53,282 pounds per hour through the stove against an average flow of 166,174 pounds of air per hour. The gas yields from 76 to 78 of its total available heat to the stove and the air withdrawn from 56 to 60 per cent, so that the air withdraws the heat from the stove nearly three times as fast as the gas delivers it.

Table XVIII.

GAS ANALYSIS IN CHECKER CHAMBERS

Date.	Time of sample.	Hole.	Distance from shell of stove, ft. in.	Analysis CO_2	O_2	N_2	CO	Density.
Nov. 26, 1913	11:10 a. m.	D	6 0	17.0	4.9	77.9	0.2	
	12:20 p. m.			16.9	1.6	81.1	0.4	
	Average			16.95	3.25	79.50	0.30	0.081372
	11:10 a. m.	E	6 0	17.6	6.0	76.4	Nil	
	12:20 p. m.			17.0	7.0	76.0	Nil	
	Average			17.30	6.50	76.20	Nil	0.081864
	11:10 a. m.	F	6 0	16.8	7.2	76.0	Nil	
	12:20 p. m.			13.2	7.6	....	Nil	
	Average			16.80	7.40	76.0	Nil	0.081724
	11:10 a. m.	Stack No. 3		17.0	7.0	76.0	Nil	
	12:20 p. m.			16.8	6.8	76.4	Nil	
	Average			16.90	6.90	76.20	Nil	0.081735
Dec. 1, 1913	10:30 a. m. to 1:30 p. m.	Stack No. 1		18.4	6.0	75.6	Nil	0.082283
	10:30 a. m. to 1:30 p. m.	Stack No. 3		19.0	5.4	75.6	Nil	0.083319
	3:00 p. m.	E	3 9	22.0	3.6	74.4	Nil	0.083572
	3:00 p. m.	H	3 9	21.0	4.0	75.0	Nil	0.083185
	3:00 p. m.	E	7 9	20.8	2.8	76.4	Nil	0.082973
	3:00 p. m.	H	7 9	12.4	2.4	85.2	Nil	0.079334
	3:00 p. m.	H	11 9	22.8	0.6	71.2	Nil	0.079614

Skin Temperatures

Skin temperatures of the shell of the stove were taken by attaching well insulated wooden mercury wells to the stove at the points marked *S*, Fig. 5. These cups or mercury wells were made by drilling a half-inch hole deep enough to hold a thermometer in the center of a block of wood, and then splitting the block through the center to make two half wells. After attaching to the stove, the shell formed the remaining side of the cup. The wells were filled with mercury, insulated from the air, and the mercury would give the approximate temperature of the shell at the point of attachment. Simultaneous readings were taken every 15 minutes at the six points marked *A, B, C, D, E* and *F*, Fig. 6, during several complete four-hour cycles and at one or two of these points at additional intervals during the tests. The change in temperature at any one point during a cycle, as shown in the table, Fig. 6, was not over 30 degrees at the maximum point of change and usually much less, and the variation from cycle to cycle was also less.

The temperatures found during an average cycle are plotted in Fig. 6. These curves are plotted with the zero degree line running parallel to the vertical sides of shell and through the points *C D* at the top of the stoves. Arcs of circles and straight

lines across the top connect the corresponding points of the two sets of vertical curves. The average temperature is shown as a heavy line and the temperatures for gas on, gas off, before air was turned on and air off, before gas was turned on are shown as broken lines.

These curves show the maximum reading at *A*. The true maximum temperature was probably at a point between *A* and *B* as the maximum internal temperature was found to be about 65 feet from the top of the stove.

The curves show that the highest skin temperatures are on the combustion side, as would be expected, and near the bottom. The skin temperature from *B* to *D* is probably nearly constant and the temperatures on the checker side fall along a curve which is probably some function of the internal temperature.

The skin temperature naturally is some function of the radiation which varies as the difference between the fourth powers of the temperatures, according to the Stefan Boltzman law for black bodies, and these curves show that the best stove construction, as determined from the skin temperature, would be some form of the center combustion stove. If the side combustion stove is preferred for other reasons, the curves show that the loss by radiation, which on this stove is approximately 10 per cent, probably could be reduced 50 per cent by the use of some insulating substance which would have to be heavier on the combustion chamber side. Of course, the amount of heat loss by radiation which could be saved by insulation, would depend on the allowable rise of temperature above the present temperature in the stove. This rise would depend on the fusibility of the brick and its life under higher temperatures and the possible temperature obtainable by the combustion of blast furnace gas. The allowable thickness would have to be determined by experiment, and by considering the cost of the insulation required and the value of the heat saved.

Checker Temperature Curves

A series of temperatures were taken at three levels in the checker work of the stoves, through holes left in the shell and the checkers, as previously described. These temperatures were taken approximately every 3 feet, the distance being laid out to place the end of the couple approximately in the center of a channel and to get temperatures in the geometrically central channel of the stove. Temperatures were taken during 12 cycles and the isotherms shown in Fig. 7 were drawn from the temperatures as found on the two average cycles whose center temperatures were approximately the same. Although the couples were threaded through heavy iron pipe with the hot junction left exposed to the gases, great difficulty in handling and maintaining the insulation was experienced. Some of the trouble was due to supporting the 24-foot couples used, when overhanging the platform, although the ends were swung from the upper galleries and from supports. Some trouble was due to handling the heated couples and to the breaking of the insulation. These difficulties were finally overcome. All tests having doubtful readings or on which couples broke down were not considered.

Temperatures were taken through holes *D*, *E* and *F*, Fig. 7, simultaneously in the same channels during one run and through *G*, *H* and *I* simultaneously in the same channels during another. Other readings were taken simultaneously through the holes *B*, *C* and *D*, *C*, *D* and *E*, *C*, *D* and *I* at different times for correlating the various runs and readings.

Temperature readings were taken only during the time the stove was on gas as special difficulties were encountered in attempting to take readings under blast, due mainly to leakage under the high pressure and the difficulty of handling the instruments under these conditions with hot blast escaping around them.

As soon as the stove went on gas, the holes were opened and the couples inserted to the first position. The couple indicated the temperature in about two minutes. To make certain of the readings, however, the couples were allowed to remain in position for five minutes before taking the readings. The couples were then pushed to the next position and read after five minutes. The couples were thus pushed from position to position, back and forth across the stove until about 20 minutes before the stove went on air, when the couples were withdrawn and the holes made tight.

After making all corrections, the simultaneous readings taken in the same channel were plotted to temperature and position ordinates and connected by a curve. The approximate points for each 100 degrees from 400 to 1,700 degrees were then located and marked on the cross-section of the stove. This was done for the series of readings across the checkers and the isotherms for that series drawn by connecting points of equal temperature. The dotted lines in Fig. 7 are the isotherms for the first series of readings after the stove went on gas, and the full lines are for the series taken two hours later.

The curves shown in the sections *XXX*, *YYY* and *ZZZ* were obtained by locating the points where the isotherms crossed these planes and then connecting these points by a series of isotherms. These isotherms are only approximate as readings were only taken on two diameters at right angles. In section *XXX* the area completely enclosed by the 1,400-degree isotherm has a temperature below 1,400 degrees, and the area between the 1,400-degree isotherms has a temperature above 1,400 degrees. The area enclosed between two isotherms of different temperatures is at a temperature below the higher and above the lower. This applies also to the sections *YYY* and *ZZZ*.

Remembering that the gases are traveling downward, a study of these curves shows that the isotherms in the section through *D*, *E* and *F* have their low points nearer the shell than the combustion chamber, and in the section through *G*, *H* and *I* the low points are nearer the center. The distance between the isotherms for the

Table XIX.

GAS ANALYSES AT VARIOUS POINTS IN STOVE

Hole.	Dist. from inner wall, ft.	Dist. from outer wall, ft.	Time, a. m.	Gas in stove, per cent by volume. CO_2	CO	H_2	O_2	N_2	Per cent complete combustion.	Fuel gas analysis, per cent by volume. CO	H_2	CO_2	N_2
Burn'r	1	.	10:10	19.9	4.0	1.7	0.3	74.1	80.4	24.5	4.5	14.0	57.0
Burn'r	.	1	11:00	18.3	4.5	1.1	0.4	75.7	80.5	24.5	4.5	14.0	57.0
A	1	.	10:10	12.7	8.6	2.3	1.2	75.2	62.8	25.1	4.2	14.3	56.4
A	.	1	10:30	16.4	6.0	2.2	0.5	74.9	72.0	25.1	4.2	14.3	56.4
B	1	.	10:40	17.1	4.3	1.7	0.8	76.1	79.6	25.3	4.1	13.5	57.1
B	.	1	11:00	18.7	2.1	1.0	0.8	77.4	89.5	25.3	4.1	13.5	57.1
C	1	.	10:55	20.9	1.1	0.3	0.5	77.2	95.3	25.4	3.9	14.5	56.2
C	.	1	11:15	21.6	2.0	0.0	0.3	76.1	93.0	25.4	3.9	14.5	56.2
D	.	1	9:25	20.1	0.0	0.0	0.9	79.0	100.0	25.4	3.9	14.5	56.2
D	1	.	9:45	21.5	0.0	0.0	0.9	77.6	100.0	25.4	3.9	14.5	56.2
			p. m.										
E	.	1	2:20	22.9	0.0	0.0	0.9	76.2	100.0	25.3	4.1	13.5	57.1
E	1	.	2:00	22.9	0.0	0.0	0.9	76.1	100.0	25.3	4.1	13.5	57.1

same temperature at the start and two hours later is variable and is greater nearer the shell than the combustion chamber. The distance is proportional to the speed of heating of the checker work, the greater the distance, the more rapid the heating, and conversely. The gases enter the dome and checkers at temperatures which are fairly even across the combustion chamber as shown by the temperature at *C* and over the area of the checker chamber, as shown by the 1,700-degree isotherms.

Heat Transmitted

The rate of transmission and the amount of heat transmitted, as shown by Luche, Jordan and others, for gases, to solids, or liquids, and opposite, varies directly as some function of the weight of gas flowing per second per unit of area of the conduit. Then those areas of the checkers and increased radiation losses due to higher temperatures near the shell.

A number of tests were made at different times to locate the maximum temperature point in the combustion chamber. Table XXII shows the average results of these temperatures. The maximum point is located 65 feet from the top of the stove, or about 16 feet below the openings at the center of the checkers. This is shown as hole *B*, Fig. 7. These temperatures were taken with an 80-foot couple which had to be re-insulated after the completion of each run. The couple was dropped through the opening above the center of the combustion chamber, and readings taken every 10 feet.

In Table XX is shown a tabulation of the fuel gas analyses made during tests 1, 2, 3 and 4. Table XXI shows the corresponding stack gas analysis, and Table XXIII the corresponding dust and moisture determinations. These tables

Table XX.

AVERAGE RESULTS OF FUEL GAS ANALYSES

Test No.		Analysis—Per cent of volume CO_2	O_2	CO	H_2	N_2	B. T. U. per cu. ft. at 62 deg. Fahr., and 30 in. Hg. Gross.	Net.	Density of dry gas at 62 deg. Fahr. & 30 in. Hg. lb. per cu. ft.
(a)	1	13.31	0.28	25.22	3.91	57.28	94.63	92.67	0.076829
(b)	2	13.15	0.38	24.54	4.11	57.82	93.03	90.97	0.076647
(c)	3	13.12	0.46	23.38	3.88	59.16	88.49	86.53	0.076769
(d)	4	11.94	0.52	24.84	4.45	59.25	95.11	92.91	0.075890

(a) Average of 36 samples taken at 4 hour intervals, from 8:30 a. m., Sept. 15, 1913, to 4:30 a. m., Sept. 21, 1913, inclusive.

(b) Average of 26 samples taken at 4 hour intervals, from 8:30 a. m., Oct. 28, 1913, to 12:30 p. m., Nov. 1, 1913, inclusive.

(c) Average of 35 samples taken at 4 hour intervals, from 11:30 a. m., Nov. 3, 1913, to 3:30 a. m., Nov. 9, 1913, inclusive.

(d) Average of 38 samples taken at 4 hour intervals, from 11:30 a. m., Nov. 10, 1913, to 4:30 a. m., Nov. 16, 1913, inclusive.

Table XXI.

AVERAGE RESULTS STACK GAS ANALYSES

Test No.		Stack No. 1, Per cent by Volume. CO_2	O_2	N_2	CO	Stack No. 3, Per cent by Volume. CO_2	O_2	N_2	CO
(a)	1	19.91	3.99	76.08	Nil	19.92	3.91	76.17	Nil
(b)	2	17.76	5.67	76.57	Nil	17.50	5.62	76.87	Nil
(c)	3	17.66	5.34	77.00	Nil	17.89	5.14	76.97	Nil
(d)	3	16.95	5.72	77.33	Nil	(This analysis from Stack No. 2, per cent by vol.)			
(e)	4	18.14	4.70	74.09	Nil	18.01	4.90	76.81	Nil

(a) Average of 36 samples taken at 4 hour intervals, from 8:30 a. m., Sept. 15, 1913, to 4:30 a. m., Sept. 21, 1913, inclusive.

(b) Average of 26 samples taken at 4 hour intervals, from 8:30 a. m., Oct. 30, 1913, to 12:30 p. m., Nov. 1, 1913, inclusive.

(c) Average of 35 samples taken at 4 hour intervals, from 11:30 a. m., Nov. 3, 1913, to 3:30 a. m., Nov. 9, 1913, inclusive.

(d) Average of 22 samples taken at 4 hour intervals from 3:30 p. m., Nov. 6, 1913, to 3:30 a. m., Nov. 9, 1913, inclusive.

(e) Average of 38 samples taken at 4 hour intervals from 11:30 a. m., Nov. 10, 1913, to 4:30 a. m., Nov. 16, 1913, inclusive.

which are heating more rapidly than others have more gases flowing through them. These curves then show a very uneven distribution of the gases flowing through the checkers, and that the greatest flow is at or near the shell, and probably has its maximum flow in an area approximating a circular band following the outline of the shell.

The dotted isotherms also indicate the thermal condition of the checkers after passing the blast and show that the blast is also poorly distributed, especially as the heavy flow is nearer the combustion chamber distributing mainly through the center and sides on section *G*, *H* and *I*. This poor distribution of the flow of gases is very serious in its effects, especially as the concentration of the flow of gas and air are in different parts of the checker work. This tends to give lower stove efficiency due to poor heat interchange between gas and air

show the fuel and combustion conditions obtained during these tests.

Table XVIII shows two series of analyses made on the gases in the checker chambers. The first series shows one of the few cases found where combustion was not complete before the gases reached the checkers. In the second series it will be noticed that toward the shell the gases show a higher density.

In Table XIX are shown analyses of the gases at different points in the combustion chamber and checkers and corresponding fuel gas analyses. It will be noticed that the gas burns progressively in vertical layers, that the samples above burner always showed poorer combustion than at the burner level, and that combustion was not complete until the gases had passed into the dome of the stove.

Throughout the runs it was found that the gas was burning explosively, vibrating the stove and its surroundings, and throwing out flame around the burner. All pressure instruments in connection with the gas system showed the effects of this vibration, which was actually traced from the chimney valves to the gas in the mains approaching the stove. With three chimney valves this vibration increased in rapidity but not in intensity.

Gas Burners

A whirling device was added to the burner, which slowly whirled the air entering the burner. This arrangement practically decreased the vibrations in the combustion chamber and permitted a decrease in the air supply. The chimney gas analysis with these valves on showed an average of 1.6 to 2.4 per cent O_2 with no CO. The combustion chamber temperature at the 50-foot level was increased by from 50 to 75 degrees Fahr., and the stove continually increased in temperature. Repeated attempts were made to obtain a complete eight-hour test with this burner, but conditions at the furnace were such that the blast was very unsteady. It was not possible to obtain a balance on the stove as the final temperature of the blast was from 100 to 150 degrees higher at the end of the test than at the start, and even when holding the stove for 15 minutes past its regular time, no balance could be obtained. In connection with the temperature work in the checker chamber, attempts were made to take pitot tube readings at various points to obtain the actual velocities of the gas at these points. The vibrations of the gas were so severe that it was found impracticable to obtain any readings of value.

The results shown by the test follow:

One—Improvement can be made in the distribution of gases through the

checker work on stove. The dome does not fully accomplish this. It may be possible that a baffle or change in bridge wall height could be added to advantage in the dome.

Two — The stove gives better efficiency when using three chimney valves.

Three — Prolonged tests are practicable and give much more reliable results on which to base conclusions than do short tests.

Four — A much more efficient burner can be perfected so as to get better combustion. It may require gas and air regulators in order that the right quantities of gas and air can be premixed to obtain the best efficiency.

Five — The velocity of the gas passing through the stove is very low compared with that of the air and the air withdraws the heat from the stove much faster than the gas supplies the heat. This ratio is approximately that of the weight of gases flowing per hour.

Six—Loss from chimney gases (approximately 20 per cent) is well worth saving by heat exchangers for preheating the blast before its entry to stove or for preheating the air used for combustion of the gases burnt in the stove. A very desirable arrangement would be a fan under slight pressure to force the air required for stove burners through a preheater of this kind. All the mixing should be done in the burner. The additional temperature of air and the slight forced draught would aid greatly in obtaining a higher combustion temperature in the lower part of the combustion chamber, shorten the flame and confine all the combustion to the combustion chamber, so that the hot products of combustion alone will pass through the checker work. In many cases the combustion is not complete at the top of the checkers.

Seven—Radiation losses amount to from 7 to 12 per cent from the exposed surface of the stove. It may be possible to find a more efficient insulation between the brick work and the shell.

Washed Gas for Blast Furnace Stoves

The use of clean gas in blast furnace stoves is absolutely necessary to secure the most efficient results. With clean gas, smaller checker openings can be used and greater heating surface obtained. Less dust is blown through the hot blast valves, pipes and tuyeres and these are not cut so badly. Repairs required on this equipment or on the linings of the stoves are decreased. Perfect combustion also can be secured with clean gas and a uniform heat is ready at all times for the blast furnace. It would be impossible to obtain these results with dirty gas, due to the plugging up of checker openings and the filling up of the stove wells with clinker, which is difficult to remove and injures the walls of the combustion chambers and decreases the heat absorption of the entire brickwork of the stove.

The usual practice for a plant containing several blast furnaces is to use an efficient dust catcher on each furnace. Additional auxiliary dry dust catchers or dry cleaners also are used to catch as much of the heavy material sent over with the blast furnace gases as possible, as this material is valuable and is handled more easily in the dry state. From here, the gas is collected in one central dirty gas main and conducted to the washers, or it can be used directly as dirty gas in emergencies. This arrangement tends to equalize the variations in the composition and amount of gas given off by the different furnaces and better and more regular results are obtained.

Table XXII.

TEMPERATURE IN COMBUSTION CHAMBER

Time, minutes.	Location from top, feet.	Temperature, degrees, Fahr.
0	75	2175
10	65	2225
20	55	2121
30	45	2045
40	35	2050
50	25	1951
60	15	1894
70	6	1863

Power Plants

The most important point in all gas washing processes is to cool the gas sufficiently to precipitate the moisture and eliminate it from the gas. The ideal condition for blast furnace stoves or boilers would be a hot gas containing no dirt or moisture, but very good results are obtained with a dirt content in the gas of 0.15 per cent of a grain per cubic foot and a temperature of 70 degrees, which corresponds to a moisture content of eight grains per cubic foot at saturation.

More thought and study is now being given to blast furnace power plants as it is realized that steam practice in furnace plants is not comparable with that of modern central power stations. Most of the large blast furnace plants in this country have been gradually increased in capacity by adding one or two additional furnaces from time to time, as the additional product is required. In most cases this has resulted in separate boiler houses and blowing plants being installed for each new set of furnaces. This practice has not tended toward lower operating costs or increased fuel economy. Efficiency is increased to some extent by connecting the gas and steam lines from all the various units.

Table XXIII.

DUST AND MOISTURE IN BLAST FURNACE GAS

	Test No. 1.	Test No. 2.	Test No. 3.	Test No. 4.
Moisture	7.413	5.6885	5.5469	4.8614
Dust	0.07186	0.0811	0.1385	0.1876

It is important to concentrate power plants as much as possible to effect savings in operating cost, as well as in fuel. If boilers are used, the boiler plants should be as few as possible and consist of large units, keeping to a minimum the number of units required for large powers, as the maximum concentration of power is always an advantage to effect savings in costs. The steam pressure used should be 175 pounds or more and the plant should have all modern economical appliances such as superheaters, feed water heaters and, when necessary, water treating plants, fuel economizers, etc. Higher boiler efficiencies can be attained by careful study of these various details through the more efficient burning of gas on gas-fired boilers, the adoption of time-firing of coal as practised on marine coal-fired boilers, or by the use of powdered coal. By attention to such details it should be possible to raise the average boiler efficiency well up toward 80 per cent. It is preferable to have a separate boiler house in a blast furnace plant on account of the dust, dirt and gas unavoidable around plants of this kind.

In making a selection of steam blowing engines, turbo blowers, or gas blowing engines, as well as steam turbines or gas engines for power purposes, the local conditions regarding the value of fuel must be studied, as well as the considerations as to whether there is an outlet for excess power in connection with other departments, such as steel works or other industrial plants.

The Use of Dry Blast

In the first installment the importance of eliminating moisture was considered, and attention called to the Gayley dry blast process. This process aids in securing more regular and successful blast furnace practice, as in addition to producing uniform moisture content in the air blast, it gives the furnace a uniform supply of oxygen by weight. Mr. Gayley's original claim "that with an increase in output of 10 per cent, the amount of fuel per ton of iron will be reduced 10 per cent", has been borne out by later experience with plants using dry blast . There have been instances where the results were disappointing, as much greater savings were expected than Mr. Gayley originally claimed. The results of special cases should not be considered, however, but the average results of all in-

stallations should be accepted as decisive.

There are special instances where a furnace is on very low coke per ton of iron, say from 1,600 to 1,800 pounds, when conditions happen to be most favorable, but this is not an average condition. In such cases, the entire saving could not be expected. Even on that basis, there would be a gain owing to the increased regularity due to dry blast. It should be remembered that the quantity of carbon in a blast furnace must always be sufficient to maintain a reducing action in the gas produced by oxidation of fuel at the tuyeres.

When hot blast was first introduced in Scotland by Nielson, great economies were effected, and its use spread rapidly through Scotland. When its advantages became known, installations were made in other countries, but in some cases the savings in coke consumption and increased production were not so great as the local furnace practice did not offer the same comparison as the Scottish. In all instances, its introduction was accompanied by increased production, and with marked economy in fuel.

Future Developments

The application of the sciences of physics and chemistry to blast furnace practice has made a wonderful transformation in the manufacture of iron. What can be expected in the way of future advancement?

With the exception of coke and some additional treatment required for ores, the raw materials will remain practically the same. By-product coke will replace all bee-hive coke operations, as its manufacture allows the mixture of various kinds of coal, and permits the use of large quantities of coals which alone are not suitable for bee-hive coke manufacture. Coke oven gas, tar, ammonium sulphate and benzol will be recovered. More use will be made of blast furnace cinder, which will be commercialized to a much greater extent, not only for cement, ballast and road material, but also for making a good quality of building and paving brick, which already has been done very successfully.

The location of a plant should be chosen, not only with reference to the market for its principal product, but with careful consideration to the outlet for its almost equally important by-products.

In many instances, the advancement in appliances for the economical handling of materials around blast furnace plants has been so great that it is a question how far this can be carried and still show a profit on the investment.

Blast furnace plants having a number of furnaces, can effect economies by the concentration of their plants to as great an extent as possible.

Where boilers are used, large units should be installed, and in as few boiler houses as possible. The same applies to both steam or gas blowing engines or turbo blowers, power houses, pump houses, etc. Wherever possible, all power and pump stations should be combined under one roof, to reduce the operating expense. The boiler houses, as stated previously, should be located in a separate building.

In power stations the importance of combining the various thermal processes in series, and rejecting the remaining heat at the lowest possible temperature, is fully realized. This is also true in the use of blast furnace gas for other purposes, such as in stoves, all of which economies tend not only to lower the cost of production, but are of great importance as an aid in the matter of conservation of our national resources.

Regarding the fuel consumption of a blast furnace, when it has been reduced to approximately 2,000 pounds per ton of iron, it is a question under some conditions, whether it is desirable to endeavor to bring it very much lower, as our greatest future economies will come from the economical use of the waste gases from blast furnaces, especially when connected with large steel works.

These thermal economies will be secured by—

First—Increased efficiency of hot blast stoves, which may be obtained by reducing the present losses due to radiation; the use of larger checker surfaces exposed to the passage of gases; more efficient burning of gas in stoves; and by the utilization of the waste heat from stove stacks for either preheating the blast before its entry into the stove or preheating the air for mixing with the gas for combustion.

Second—Increased efficiency from blast furnace power plants by using gas engines or more modern steam equipment; and when gas engines are used, increased efficiency will result by saving the heat of the waste gases and cooling water.

Third—Increased efficiency thermally by utilizing the sensible heat now lost in the molten iron and slag. This loss is quite serious, as was shown in the preceding installment, heat in pig iron amounting to 5.39 per cent, and heat in slag to 6.25 per cent of the total heat derived from the coke of the burden.

These losses have already been studied and efforts are constantly being made to decrease losses in these directions. Much has already been done to effect savings. The latest saving has been effected by utilizing the heat from slag to indirectly generate steam for low pressure turbines. Savings will eventually be made in the case of the molten iron.

The maximum utilization of all the by-products in connection with the manufacture of iron is the goal towards which all must strive for the future advancement of the art.

More Houses Needed

Mayor C. B. Wilson, of Bridgeport, Conn., has sent a special communication to the common council urging that steps be taken to provide living accommodations for the estimated increase of 40,000 population expected from the activities of local war munition manufactories. He considers that immediate action is necessary to provide homes for that number. At the Remington works alone it is estimated 9,000 men will be employed by Jan. 1, and that this number will be further increased at the rate of 1,000 a month until a total of 14,000 men are employed. Mayor Wilson is being assisted in grappling with the problem by the city plan commission and the Bridgeport housing commission. Other Connecticut cities and towns are rapidly increasing in population on account of war orders coming to their manufacturers, and some of them are expected to double in population inside of two years, whether the war lasts that long or not.

Leased Plant

Norwich, Conn., June 22.—The Hopkins & Allen Arms Co., which is to make 400,000 rifles for the British government, has leased the plant of C. B. Rogers & Co., manufacturers of woodworking machinery, and will occupy it in filling its war contract. This is the second factory leased by the reorganized company in addition to its own extensive plant. The bulk of the machinery for the company's new buildings and much that will go into the Franklin street plant, is expected to arrive during August. Draughtsmen are now at work on tools to be used. As soon as these are finished work will be started on the initial operations, and the company expects to employ 2,000 men. Screws, sights and other small parts of the guns will be made in other plants of the company in Massachusetts and Vermont, but the barrels will be built here and the rifles assembled and shipped from the local factories.

Money and Iron: Fact and Comment

Interesting Report of a Southern Company—Flow of Gold to This Country Brings Its Problems

The report of President James Bowron, of the Gulf States Steel Co., gives some idea of the many difficulties that have been encountered in improving the financial condition of that company. The business owned by the company consists of that which was established by the Alabama Steel & Wire Co. in 1899, merged into the Southern Steel Co., which became bankrupt in 1907, reorganized as the Southern Iron & Steel Co. in 1909, and again became bankrupt in 1912. The property was handled by Mr. Bowron as receiver and trustee until Jan. 31, 1913, when it was sold to the nominees of the reorganization committee an transferred by them to a temporary holding company, the Standard Steel Co. On Dec. 31, 1913, all assets and liabilities of the Standard Steel Co. were transferred to the Gulf States Steel Co. The Tennessee properties were relinquished by the Southern Iron & Steel Co., prior to its bankruptcy, and other steps were taken to cut out dead wood. The company then turned its attention to obtaining an ore supply and acquired 1,604 acres of ore lands in the Birmingham - Bessemer - Oxmoor distict, paying therefor $200,000 in cash and assuming $289,000 of outstanding bonds, the remainder of the consideration being common stock of the Gulf States Steel Co. This property is being developed and it is expected that ore will be reached toward the end of this year. The company has spent $113,558 in blast furnace improvements, thereby increasing the blast furnace production at Alabama City to 288 tons per day, compared with 211 tons per day for the two preceding years, while the cost of pig iron has been reduced $1.31 below the average cost of the two preceding years.

The company has installed additional equipment in its wire mill, increasing its capacity in the two most profitable fields of its manufacture. Its sales of field fence increased from 621 tons in 1910 to 11,195 tons in 1914, and of bale ties from 27 tons in 1910 to 578 tons in 1914. At the bar mill the loading yard was reconstructed entirely, so that 12 cars now may be loaded with bar steel instead of two, as formerly.

General Conditions Poor.

The foregoing recital mentions only a few of the improvements which have been made steadily by an economical expenditure of the limited funds at disposal, but they may convey some idea of the herculean task Mr. Bowron and his associates have faced in their efforts to make the Gulf States Steel Co. a paying proposition. And this, too, in a period when practically all iron and steel companies, both northern and southern, have been laboring under the handicap of severe industrial depression. In this connection Mr. Bowron says:

"Since its formation, the company has had to face the disturbances of trade incidental to a changed fiscal system, based on low tariff duties and most of our leading products coming in free to gulf states seaports; the radical change in financial affairs and credits, due to the adoption of a new system in banking; and, worst of all, the unprecedented difficulty imposed upon our customers throughout the gulf states by the rude disturbance to movement and marketing of cotton, due to the European war. The last named condition has crippled the purchasing ability of thousands of customers who inight have bought our products."

Stock Outstanding.

The company has outstanding the following securities: $1,260,000 first preferred, 7 per cent stock; $3,107,069 second preferred 6 per cent stock and $3,264,307 common stock, leaving under the control of the company for future sale $1,740,000 first preferred 7 per cent stock, $1,892,930 second preferred stock and $4,215,692 common stock.

During the period of management by the receiver and trustee, freed from charges for funded debt, a regular profit was made, aggregating, after deducting idle expense, taxes, insurance and interest, $54,389 for six months from Aug. 1, 1912, to Jan. 31, 1913, inclusive.

The earnings from Feb. 1, 1913, 11 months, 10 under the Standard Steel Co. and the last month under the Gulf States Steel Co., amounted to $163,381.

The net earnings of the year 1914 amounted to $115,623, although working half time on the account of the war's interference with business October, November and December.

Estimated net earnings for January, 1915, were $12,396; February, $29,924; March, $50,231; April, $59,317. Total to May 1, 1915, $151,869.

Receivers Named

Receivers have been named for the Pittsburgh Contracting Co., of 17 Battery place, New York City, which was petitioned in bankruptcy several days ago. Charles Burlingham and Geo. H. Flinn are the receivers. The company has contracts on the Catskill water system and is said to have assigned these to the Liberty National bank for loans. This claim of the bank is said to have been secured and guaranteed by Booth & Flinn, Ltd., and by Wm. Flinn, individually. The liabilities outside of the claim of the Liberty National bank are said to be about $200,000 and the assets $60,000.

Authorized to Sell

Judge Edgar Aldrich, in the United States district court at Boston, June 18, granted authority to the three Massachusetts receivers of the Pope Mfg. Co., to sell the assets by auction by July 20, the upset price being fixed at $725,000, which is the amount offered by H. Preston Cousens, representing a New York syndicate. At the price offered, the unsecured creditors should receive about 90 per cent of their claims, inclusive of dividends from the Connecticut company, of which Col. George Pope is the sole receiver.

The report of the receivers was allowed, but it does not include compensation for them or counsel fees. In the report the receivers state that a new plan of reorganization has been presented by the creditors. They claim that the plant in Westfield, Mass., can be operated economically and successfully, for an indefinite period, only by the use of considerable of the cash on hand.

Business Improves in South America

Reports as to conditions in Argentina indicate marked improvement. Crops of wheat and linseed have been fairly good and prices very high, while wool exports brought record prices. Everything points to a record corn crop, with prices remaining high. While the international moratorium is still in existence, Mr. Allen, of the Buenos Aires branch of the National City Bank of New York, expresses

the opinion that if United States merchants exercise discretion in according credit of approximately 90 days sight, keeping in close touch with the New York office of the National City bank, they will be assuming no more than the ordinary business risk incident to commercial transactions when carried on between different countries.

Exports to South America in the last three months show a gratifying improvement when compared with the earlier part of the war period. Exports to South America showed a marked falling off in each month from August to the close of February, but in March were about $2,000,000 more than in the same month of last year, and April showed another gain of about $2,000,000, the total for March and April to all South America being about 25 per cent in excess of the same months of last year.

May exports to Argentina from the port of New York include $207,000 worth of iron and steel manufactures, $63,000 worth of agricultural machinery, $88,000 worth of packing house machinery, $20,000 worth of automobiles and $63,000 worth of electrical supplies. May exports to Uruguay included about $70,000 worth of iron and steel manufactures, $50,000 worth of tin plate and $16,000 worth of hardware.

Industrial Stocks

With a golden stream coming into this country from foreign lands and sterling exchange making the lowest record in a generation, the past week has called attention in a most impressive way to the seriousness of the financial problems connected with the great war. If the exporting of American products continues in as large volume as during the past two or three months, the further decline of sterling exchange would seem to be inevitable. Just how this situation will be worked out, no one can predict, but American investors doubtless will be asked to subscribe to a large part of the new billion-dollar British loan, the proceeds of which will, it is expected, be devoted largely to the purchase of supplies in this country.

The week opened Monday with a general decline of from 1 to 2 points. Demand bills on England sank to $4.77½ for the pound sterling. Another decline in sterling Tuesday interfered with the operations of the bulls. Westinghouse stocks were strong on account of a rumor that the company had been offered another big contract for war supplies. After some unsteadiness in the earlier part of the day Wednesday, there was an advance in the last hours. Thursday, the feeling was fairly optimistic. At Cleveland American Multigraph Co. stock took its rank among the war stocks, owing to the report that it is considering taking on a large contract for war supplies. It opened at par, advanced one-eighth and closed at that figure bid. American Multigraph made a new high record Friday, when it touched 23½. Investors generally were inclined to be conservative Saturday and the changes for the week show mixed results.

Quotations at the close of business June 19 and changes in the leading stocks identified with the iron and steel industry for the week are shown in the following table:

	Close June 19.	Net change.
Amer. Brake Shoe & Fdy. Co.	...	.....
Amer. Brake Shoe & Fdy. Co., ctfs, prfd.	148½	+ ½
American Can	45⅛	—1½
American Can, prfd.	103⅞	+ ⅜
Amer. Car & Foundry Co.	55⅛	— ⅞
Amer. Car & Fdy. Co., prfd.	114	—2
American Locomotive	51¾	+2
American Locomotive, prfd.	96	+1
American Steel Foundries	37⅞	+2⅛
Baldwin Locomotive	66⅜	+7½
Baldwin Locomotive, prfd.	103½	—1⅜
Bethlehem Steel	163¼	—3¾
Bethlehem Steel, prfd.	116½	—1⅞
Colorado Fuel & Iron	32⅜	+ ⅛
Continental Can	68	+4
Continental Can, prfd.	100	+2½
General Electric	172¼	— ⅝
International Harv. of N. J.	104	.....
Inter. Harv. Corp.	.....	.....
Inter. Harv. Corp., prfd.	.....	.....
Nat'l Enamel'g & Stamp. Co.	16½	— ¼
Nat'l. Enamel. & Stamp Co., prfd.	.....	.....
Pressed Steel Car	49	+ ⅛
Pressed Steel Car, prfd.	.....	.....
Pullman Palace Car	160¼	—1¾
Republic Iron & Steel Co.	29½	— ½
Republic Iron & Steel Co., prfd.	87½	0
U. S. Cast Iron Pipe & Fdy.	13⅝	—2
U. S. Cast Iron Pipe & Fdy., prfd.	40⅛	—3⅞
United States Steel	60⅜	— ⅜
United States Steel, prfd.	110	+1
Westinghouse Mfg.	97⅜	— ⅝

Financial Notes

The American Locomotive Co. has declared the regular quarterly dividend of 1¾ per cent on the preferred stock.

The Van Dorn Iron Works Co., Cleveland, has declared the quarterly dividend of 1¾ per cent, payable July 1. Books close June 22.

The Westinghouse Electric & Mfg. Co., Pittsburgh, has declared the regular quarterly dividends of 1¾ per cent on the preferred stock and 1 per cent on the common stock. The preferred is payable July 15 to stock of record June 30. The common is payable July 30 to stock of record June 30. Retiring officers of the company were re-elected by directors at the meeting Thursday.

Stockholders of the Kelly Island Lime & Transportation Co. have increased the number of directors, adding to the board H. G. Dalton, of Pickands, Mather & Co. Charles R. Morley, of Cleveland, also takes the place of Director George B. Morley, of Saginaw, Mich. The board declared the regular quarterly dividend of 2 per cent, payable July 1. Books close June 19. All officers were re-elected.

The receivership of the Alton Steel Co., Alton, Ill., a $500,000 corporation, organized for the manufacture of hoop steel, was ended in the court at Edwardsville, Ill., on June 16. James Duncan, of Alton, was appointed receiver July 8, 1914, about a year after the company began operations.

At a meeting of directors of the Wheeling Steel & Iron Co., Wheeling, W. Va., June 17, it was decided to call a special meeting of stockholders, June 30, to consider a resolution providing for an issue of first mortgage 6 per cent bonds to the amount of $5,000,000. Of this issue, part will be disposed at drafting and part later. It is the intention of the company to extend plants in the Wheeling district. Numerous improvements are being considered and it is probable several additions will be made.

A voluntary petition in bankruptcy has been filed in the United States district court of New York City against the Pittsburgh Contracting Co., which has been engaged upon a large contract for the construction of a section of the Catskill aqueduct, in this city. This work is in the final stages of completion. Geo. H. Flynn, of Pittsburgh, is president, and Wm. A. Flynn, of Pittsburgh, vice president, of the company. The company has a capitalization of $1,000,000. The bankruptcy petition by creditors is said to be the outcome of losses on unprofitable contracts.

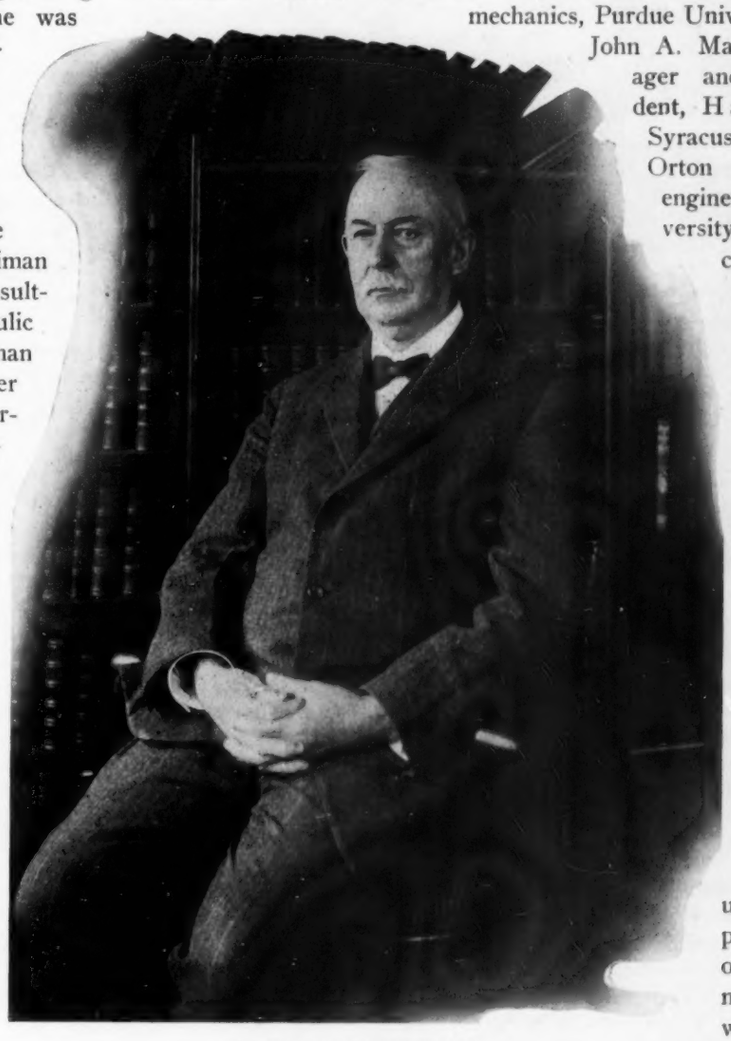
The Maynard H. Murch Co., investment brokers, Cleveland, has purchased $300,000 7 per cent cumulative preferred stock of the Cleveland Metal Products Co. Shareholders of the Cleveland Foundry Co. own the stock of the Metal Products company, and during the life of an issue of $300,000 of bonds of the metals company guarantee the principal and dividends of the new preferred stock. The proceeds of the sale of the stock will be used to extend the business and for additional working capital. The company manufactures enamel ware and is specializing in sheet aluminum and aluminum kitchen ware. The net worth of the company's properties, covering 17 acres on Ivanhoe road, after all debts, is $750,000.

The new plant of the Alloy-Steel Forging Co., at Carnegie, Pa., started operations last week. The works of the company formerly were located at Braeburn, Pa. The main building is 100 x 300 feet, it has two 25-foot bays and one 50-foot bay.

New President is a Man of Mark

Head of American Society for Testing Materials Has Had a Distinguished Career—Was a Charter Member

MANSFIELD MERRIMAN, the newly elected president of the Amereican Society for Testing Materials, has been recognized for many years as one of the foremost authorities on civil engineering in this country. Mr. Merriman was born in Southington, Conn., in 1848, and received his education at Sheffield Scientific School, Yale University, graduating in the class of 1871 with the degree of bachelor of philosophy. A year later he received the degree of civil engineer, and in 1876 the degree of doctor of philosophy. Another degree bestowed upon Mr. Merriman is that of doctor of science, which he received from the University of Pennsylvania in 1906. Mr. Merriman began his career as an assistant engineer in the United States engineering corps. From 1875 to 1878 he was an instructor in civil engineering in Sheffield School. In the latter year, he was called to Lehigh University as professor of civil engineering. This post he occupied for nearly 30 years, his resignation taking place in 1907. Since that time, Mr. Merriman has practiced as a consulting, civil and hydraulic engineer. Mr. Merriman was one of the charter members of the American Societey for Testing Materials and, prior to its formation in 1902 under its present title, was, for many years, a member of the International Association for Testing Materials. When the American members originally organized in 1898, as the American section of the International Association, Mr. Merriman was elected chairman, serving in this office from 1898 to 1900. Mr. Merriman is the author of "numerous text books on civil and hydraulic engineering. His works include: "Method of Least Squares"; "Mechanics of Materials"; "Treatise on Hydraulics"; "Strength of Materials"; "Precise Surveying and Geodesy"; "Elements of Sanitary Engineering", and other. He was editor-in-chief of the *American Civil Engineers' Pocketbook,* published in 1910. Mr. Merriman resides at 1071 Madison avenue, New York City.



MANSFIELD MERRIMAN,
President American Society for Testing Materials

At the annual meeting of the American Society for Testing Materials, at which Mr. Merriman was elected president, Wm. H. Bixby, retired brigadier-general, United States Army, was elected vice president and the following were chosen for membership on the executive committee: James H. Gibboney, chief chemist, Norfolk & Western Railroad Co., Roanoke, Va.; William K. Hatt, professor of applied mechanics, Purdue University, Lafayette, Ind.; John A. Mathews, operating manager and general superintendent, Halcomb Steel Co., Syracuse, N. Y., and Edward Orton Jr., dean, college of engineering, Ohio State University, Columbus. The Society has grown rapidly in membership in recent years. The total enrollment now is 1,842, as compared with 1,687 last year, or a net gain of 155. The gain the previous year was 113 and the average increase for the preceding five years was 105. It is not, however, in membership alone that the society is growing. Its influence is much greater than in earlier years and its specifications are much more widely used. Details as to this progress were pointed out at the New York meeting, a report of which appears elsewhere in this issue.

Business Men May Fall Into Trap

Federal Trade Commission May Attempt to Exercise Power Not Granted by Law and Prosecutions May Follow

Washington, June 22.—James A. Emery, general counsel of the National Council for Industrial Defense, has sounded a note of warning to business men in regard to the federal trade commission's attitude toward business combinations. There is, he believes, danger in accepting at face value the apparent desire of the commission to hold out the olive branch to such combinations, giving an impression that it would go to almost any length to encourage them, and thus unconsciously lead them into a legal trap. *The Iron Trade Review* recently called attention to the fact that the commission appeared to have taken an uncalled for conciliatory attitude toward business, as though it feared, before taking up its duties, that it was under suspicion as being antagonistic toward business.

The commission is a new governmental body having to do with business", or destructive helplessness, or in the business world, and its services, whether one of "constructive-helpfulness", or destructive helplessness, or indifference, remains to be performed. It is plain that the business interests have manifested a willingness to cooperate with it and assist it in its work wherever possible, even though an element of concern naturally sprang into existence. The fact that the chamber of commerce of the United States, by referendum, voted favorably toward the creation of such a commission, and has appointed a committee to co-operate with it, along with the fact that leading business men appeared before it and offered valuable suggestions at hearings in Boston and New York, denotes that the business world is desirous of aiding the commission. But even before, as well as after that body was created, the administration's attitude seems to have been one of tender solicitude for business combinations, and may have unintentionally deluded business interests into false notions. Members of the commission appear to be zealous in proclaiming their friendly and sympathetic attitude toward the anxieties of business men. Mr. Emery believes that one of the most dangerous tendencies is a certain apparent willingness to assert a power which the commission does not possess under the act which created it. He has intimated that the commission has at least privately, if not publicly, advanced opinions with respect to whether or not combinations or contracts in interstate commerce may be thought to violate the anti-trust acts.

It has been pointed out by Mr. Emery that the federal trade commission act makes it plain that the only time when the commission may investigate for the purpose of assisting a corporation to conform to the law is when the attorney general requests the commission to do so after the corporation is charged with violating the anti-trust acts.

Investigation by *The Iron Trade Review* proves that his contention is amply supported by section 6, subdivision e, of the federal trade commission act, which says the commission shall have the power—

"Upon the application of the attorney general to investigate and make recommendations for the readjustment of the business of any corporation alleged to be violating the anti-trust acts in order that the corporation may thereafter maintain its organization, management and conduct of business in accordance with law."

Many Deluded

Many business men and business organizations, Mr. Emery said, were deluded into supporting a proposal for a trade commission in the belief that it would afford an opportunity for practical affirmative advice regarding the relation of contracts and combinations affecting interstate trade to the anti-trust act. The intention of Congress, however, was made clear by the rejection of an amendment proposed by Senator Lippitt, Republican, of Rhode Island, which would have accomplished this identical result. His amendment provided that any corporation might submit a form of combination or contracts affecting or intended to affect commerce between the states. The commission could require such information as it desired in order to understand proposals, and during their consideration by the commission no person or corporation a party to them would be subjected to prosecution. If, in the opinion of the commission, their necessary effect and the intent of those a party to them were not to produce a violation of the anti-trust laws, the commission would issue a certificate to that effect, revocable at any time on notice and hearing. During the life of that certificate no person or corporation a party to such contracts or combinations was to be prosecuted under the anti-trust laws until a court of competent jurisdiction had held contrary to the ruling of the commission. The assertion of those that such an amendment would be analogous to an "immunity bath" was a mere play upon a moss-covered phrase, and had no basis in fact. The amendment would plainly hold the corporations under the strict jurisdiction of the laws in every sense of the word. The revocation and prosecution features provided prove the statement.

Power of Government Limited

Such a proposal is as for as this government can go in giving assurance to sincere men of the conformity of their conduct or combination to the anti-trust acts. But the rejection of this proposal, accompanied by specific statements from Senator Cummins, Republican, of Iowa, and Senator Walsh, Democrat, of Montana, leading proponents of the federal trade commission act, that the commission was not intended to draft a code of ethics for business men or to give advance opinion respecting their conduct, disposes of the contention that the commission now possesses the power, except in the foregoing named instance, to give affirmative guidance to the matter of business combination.

Should the commission, in an effort to gain the good will of business, through an erroneous idea of its own power, usurp this authority, the last condition of business would be worse than the first. That is true, because for the opinion of the commission, publicly expressed, is not an estoppel either to private suits for damage or public prosecuution by the district attorneys or the attorney general under the Clayton act or the Sherman act. Business men, deluded into submitting contracts and arrangements for inspection of the commission, might thus provide the most powerful impulse to vexatious and injurious proceedings against themselves by public authority or private antagonists. Corporations secure no immunity by self-incrimination.

Experience under a recent administration has demonstrated the danger of complacently proceeding under unofficial assurance from high authority.

Working Out Great Problems

How They Are Effected by The Specifications of The American Society For Testing Materials

By A. W. GIBBS

IT IS with much diffidence that I ask you to consider the effect of the specifications of the American Society for Testing Materials in the working out of one of the great transportation problems in which we are all vitally interested. That the large number of rail failures has attracted no more attention is because of the vigilance of the track inspection. In the very great majority of cases the rails are removed before any serious results ensue, but we must not take too much comfort from this fact, for each case offers the possibility of most serious consequences, and this is fully recognized.

Against these unsatisfactory conditions we have several possible solutions: Better steel, in the sense of more uniform steel; better steel in connection with more rational sections; materially heavier sections; or retrogression in loads and speeds. To date, a combination of the first and second has been chosen. There has been a very general change to open-hearth steel, at an increased cost.

Committees of various societies have worked almost continuously on the subject of specifications. Today, after the fourth revision in a period of eight years, the A. S. T. M. specification is almost identical with that of the American Railway Engineering Association, but the seemingly small differences are really very important. Both specifications are identical in chemical requirements; both provide that the chemistry furnished by the producer shall be that of the drillings from the ladle test ingot; but both ignore the fact that the chemistry of the actual rails, at least of part of them, is apt to differ widely from the ladle analysis. In the case of the open-hearth specifications there is at least the merit of an analysis for each heat. In the case of the bessemer rail, the chemistry other than carbon is averaged from two complete analyses per 24 hours, to determine the quality. It is difficult to see how a specification could be made more absurd, and yet this clause in one form or another has been and still is part of many specifications, and it did not originate with our committee.

Neither the American Society for Testing Materials or the American Railway Engineering Association specification really protects the buyer as to chemistry. Neither puts any limit on the amount of segregation permitted, and it is well known that this ranges over wider limits than would be permitted in the ladle analysis.

When Chemists Don't Agree

In investigating the causes of the failures of individual rails, many analyses have shown such startling discrepancies between the composition of the failed rail and the analysis purporting to represent the heat, that it was difficult to believe that they could represent the same material. Either the ladle analysis is an unreliable index of the quality of the material in the rail, or there is a great need for chemical reform. We know by experience that when put to it, the chemists of the producers and the consumers can tally within very reasonable limits. This is a serious matter for the consumer. In one of the railroad wrecks due to a failed rail, the government representatives analyzed the rail and discovered that the composition did not at all agree with that called for in the specification, and severely scored the road for not enforcing its own specifications. How far the difference between chemists is due to difference in methods I do not know, but possibly the methods by which the chemistry is determined may have to be agreed upon and made a part of our specifications. Dr. C. B. Dudley, who did much work on standardizing methods of chemical analysis, would in his specifications not only state the composition required, but also the methods by which the determination was to be made.

From the physical standpoint both specifications are defective, as both contain the provision that if the test piece meets the requirements, the material will be accepted; but in the event of the failure of the first test piece, two more tests are made, and if both pass, the material is accepted. We hold that this is a pernicious practice, in that the consumer has positive proof that some of the accepted material does not meet the requirements. How this clause ever crept into the specifications, we do not know. We do know that it is nothing new. If meeting a single test means acceptance of a definite quantity of material, failure to do so should mean a definite rejection, and in a number of our other specifications this is the case.

The American Society for Testing Materials specification includes all the machinery for detecting physically unsound material by nicking and breaking, and then provides that the rails represented by these unsound test pieces shall be accepted as "special" rails. Presumably they are to be used in some unimportant location. This is another very bad practice. It is not always possible to find unimportant places. Designating marks in the way of paint or punch marks become illegible in time. The only sure way to keep such material out of important service is not to ship it from the mill. The total additional cost per ton for eliminating both of these objectionable physical clauses is quite well known and is not large. In some specifications both are cut out, but we hold that a buyer should not have to pay an additional price to avoid taking material which does not fairly meet the prescribed tests.

Summed up, the rail specification of the American Society for Testing Materials does not put a proper premium on the selection of the better part of the ingot for one of the most exacting services for which steel is used. Where the A. S. T. M. specification differs from that of the American Railway Engineering Association it is not so good.

If we consider all the steps in the development of our rail industry, we find very few improvements in methods other than those which lend themselves to increased output or reduced cost. There are some notable exceptions to this, three in particular, namely, the electric furnace, for producing better steel; the sink-head process for casting ingots, for producing better ingots; and the deseaming process, for producing better rails, by mechanically removing some surface defects which would later develop into seams. All of these processes are represented by rails actually in track under observation, but it is yet too soon to justify an opinion as to their value.

In this connection, it may be mentioned that, in addition to the sink-head process steel rails made in this

Annual address of retiring president of American Society for Testing Materials, Atlantic City meeting, 1915.

country by American methods, we have, also, a small supply of ingots made in Sheffield by the Hadfield patented process, which will shortly be rolled into rails and put in service. Heat treatment has been attempted, and such rails are actually in service under severe conditions. So far as non-service tests go, the results are promising.

Hope for Results from Uniform Steel

It is to be hoped that some of the large-scale experiments now in progress will show what is to be looked for from a more uniform product. One of these includes the requirement that the chemistry shall be from the rail, instead of from the ladle test ingot, and the segregation must be within reasonable limits. This experiment will, at least, give a quantity of fairly uniform material, so far as any practical method of representative testing will insure it. Let us hope that it will give some definite light as to how far we should go toward more uniform material.

Should it develop from the test of service that by means of more uniform steel, namely, by analysis from the finished rail, with limits of permissible segregation, we eliminate enough of our serious failures to make it worth while, we will have to face the question of how such provisions shall be carried out. It is certain that few railroad organizations have the chemists to make the determinations on the spot, so that by the time the rail is ready for shipment the makers will have advice from the chemists that the steel is acceptable. It is very desirable that this complication be avoided, but, if uniform steel proves to be the remedy, the consumers must know that they are getting it.

Aside from the work mentioned in the foregoing and some experiments on too small a scale to deserve special notice, the rail situation remains very much as it was seven or eight years ago. Any deviation from the beaten path is immediately met by an increase in the price asked, the reasonableness of which the purchaser has no means of determining. In at least one case of which I have knowledge, the actual expense of every kind, so far is it could be ascertained, due to rail breakages on a certain system, was less than one-fifth of the annual increase in the cost of rail due to the introduction of a proposed new specification designed to secure the quality of rail desired. The year taken was not an abnormal one in any way. One serious wreck would, however, entirely change this showing. It requires a lot of courage and a strong sense of duty to justify such an expenditure when the direct return is problematical.

There are many who believe that we connot hope for relief by the use of more uniform steel. They make the point that, if this is the solution, it can be obtained by a discard larger than the ordinary. They cite the records of the carriers to show that the failures, especially the breakages, are fairly well distributed throughout the ingot, so that no practicable discard would eliminate the trouble. They also call attention to the many examinations of broken rail which reveal no defect that we can recognize as such. From these conditions they argue that the only remedy is to use more steel—that is, heavier sections —without any change in the specifications as to quality. Possibly this is correct, but we would call attention to the fact that post mortems on rail sometimes give negative results, because we have not before us all the related evidence. The rail may have been damaged by unfair usage, of which there is no evidence. If due to defective support, the evidence is lost when the track is repaired. Damage from defective wheels, etc., leaves no permanent mark. There is a growing belief that the straightening press, by straining the material beyond the elastic limit, is responsible for many otherwise unexplainable failures, and it would also explain why rails from the lower part of the ingot figure so prominently in the breakage record.

The present line of progress includes a general increase in the weight of sections throughout the country. The 100-pound mark seems to be one of the halting spots, but some sections go considerably beyond this figure. A careful study has been made of the sections, and the new ones, especially of the heavier weights, are believed to be better adapted to secure good mill results, as well as better performance in the track.

Personally, I believe that the time has arrived for a considerable increase in the weight of sections, and I am not so certain that a change of quality is required at the same time. One reason that appeals is the presence within recent years of that class of failures known as "transverse fissures". So far, there seems to be no satisfactory explanation for them. It seems surprising, if this class of breakage develops in the rail, that it should not also do so in the tire, which is subject to the same intensity of pressure. The tire, however, has an immensely greater section than the head of the rail, and it is not until from one-third to one-half of the original area has been removed by wear and turning that it becomes necessary to remove the tire from service. If the mere fact of the relatively large area or section of the tire contributes immunity from this class of failure, it is fair to assume that somewhat the same result could be looked for in the case of the rail head.

Certain practices, such as the present system of straightening, have long called for improvement. Nearly all rail passes through the gagging press. The rail specifications are possibly too exacting in requiring that all rails shall be "smooth, straight in line and surface, and without any twists, waves or kinks". It is a question whether this is not asking too much for the good of the rail and whether it would not be well to make the greatest possible tolerance in the way of accepting rail with such variations from straightness as can be reasonably eliminated in laying.

Mill Methods

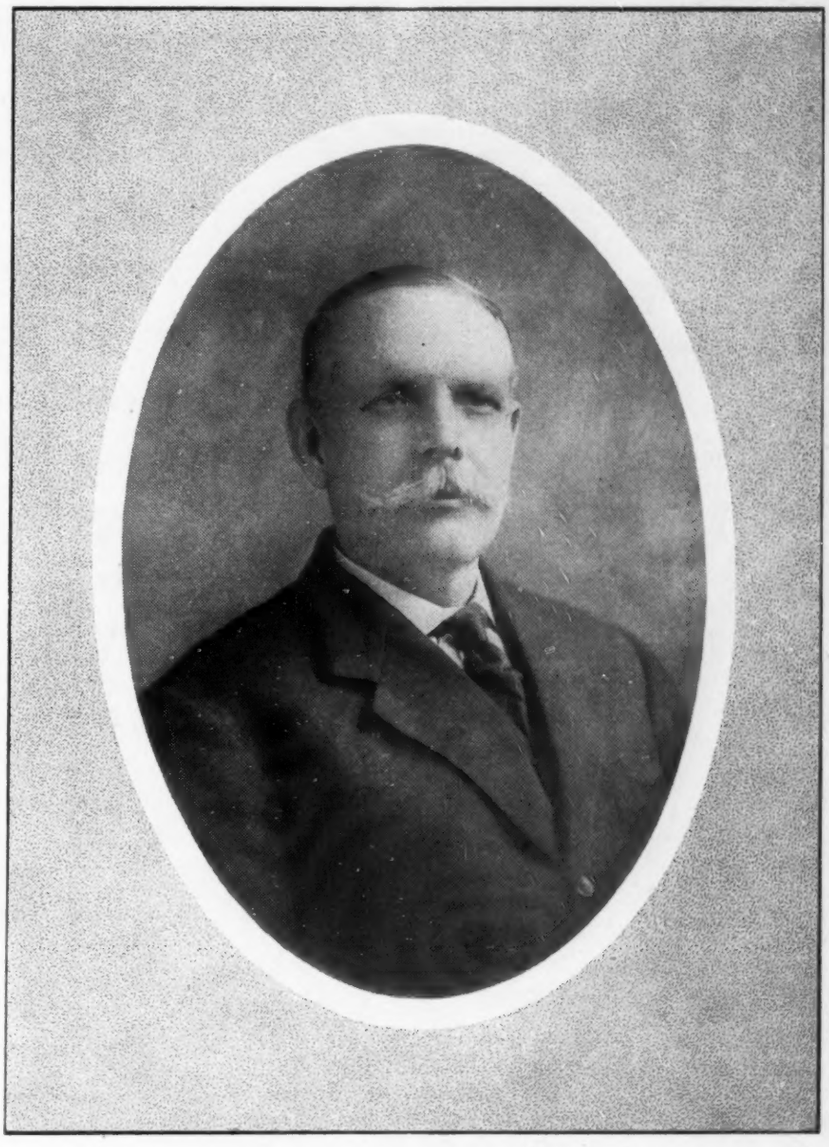
In the search for a remedy for our troubles, some have proposed to improve the product by more or less radical changes in the mill practice. It must be remembered, however, that a modern steel mill, like the railroad, can only exist by being operated on a large scale. It is designed in advance with a view to a certain sequence of operations, and if proper provision has been made for each, smooth operation follows. The mill, however, is only balanced when it performs these operations in the prearranged order, and to make a radical change—as, for instance, slow rolling, cold rolling, more passes, or one of the many other innovations suggested, may seriously unbalance the whole operation. It is not to be expected that a mill will be willing to make changes in its practice until after experimental work has demonstrated that the proposed practice is practicable and valuable. This does not mean that the mere assertion that the proposed changes are impracticable absolves us from doing anything further; on the contrary, the steel mills should be willing to go as far as possible in the direction of proving or disproving these theories.

In conclusion, I must repeat that the rail situation, as we see it, is disappointing. To add to the complexity of the situation, the government, through some of its bureaus, is taking a hand and investigating every serious failure, apportioning blame and suggesting remedies. This will probably increase rather than diminish, and may some day be very awkward for the producer as well as for the user.

The Death of Thos. D. West

THOMAS DYSON WEST, foundryman, father of literature of foundry practice in the United States and an indefatigable worker in the cause of safety, died at Glenville hospital, Cleveland, June 18, as the result of injuries received the evening before, when stuck by an automobile. Mr. West was crossing the street near his residence, when he was struck, and was removed to the hospital, where the end came a few hours later.

Mr. West was born Aug. 31, 1851, in Manchester, Eng. When an infant, he was brought to the United States by his parents and spent his childhood days in Portland, Me. When 12 years of age, he began working in the foundry of the Portland Locomotive Co. He served his apprenticeship in Portland and Bangor, and also worked for a time in New York City. In 1871, he went to Cleveland, and after attending school for about three months, became a molder at the Globe Iron Works. Somewhat later he became foreman of the Vulcan Iron Works Foundry, Cleveland, where he was known as "the boy foreman". For 14 months, he was in charge of the foundry of William Tod & Co., Youngstown, and upon returning to Cleveland, took charge of the foundry of William Fitzsimmons & Sons. He later managed the Variety Iron Works foundry and also what was known as the "Old Cuyahoga" foundry, which was considered at the time the leading large engine and machinery construction plant of the west. The Cuyahoga works were sold to the Cleveland Ship Building Co., Jan. 1, 1887. A few months later, Mr. West organized the Thos. D. West Foundry Co., with Samuel Lansdowne and Charles Neracher as associates. About a year and a half later, George H. Boyd invested money in the company, enabling it to make additions to its plant. Mr. Boyd became president and treasurer. In 1890, Mr. West went to the Alice furnace at Sharpsville, Pa., to test the practicability of making ingot molds by direct metal. This experiment, undertaken for the efirst time in this country by him, was successful and was soon generally adopted by leading companies. While Mr. West was in Sharpsville, the Cleveland plant was burned, and in 1891, the business was moved to Sharpsville, where the making of ingot mold castings by the use of direct metal was continued. In 1909, the company was taken over by the Valley Mold & Iron Co. In 1906, Mr. West organized the West Steel Casting Co., at Cleveland, which made its first castings the following year. Mr. West's son, Ralph H., has been president of the company since its organization, while the father has served as chairman of the board of directors and managing director. This company has been very successful and is now making a large addition to its plant.



THOS. D. WEST,
Foundryman, writer on foundry practice and worker in the cause of prevention of accidents

From the time he entered the foundry as a boy, Mr. West was a close student of its workings and the issue of the *American Machinist* of Jan. 1, 1881, contained the first article which he wrote for publication. His articles in that paper attracted much attention, and in 1882, his first book, entitled "American Foundry Practice", was published by John Wiley & Sons. This book is now in its twelfth edition. In 1884, Mr. West completed his second work, "Moulder's Text Book" now in its tenth edition. Upon his removal to Sharpsville, Mr. West took up the study of the metallurgy of cast iron. At that time, founders the world over were buying, mixing and testing iron by antiquated methods and Mr. West was a pioneer in advocating progressive methods. An important work was the creation and establishment of standardized drillings, which was taken over by the government in 1905. In 1897, Mr. West published his third book, "Metallurgy of Cast Iron", which has had a very large sale and is now in its fourteenth edition. His latest book, "The Efficient Man", was published in 1914. He was also the author of six instruction booklets, which he wrote for the International Correspondence School, of

Scranton, Pa. He was the author of numerous articles in *The Foundry, The Iron Trade Review* and other trade papers on foundry practice and other subjects.

Mr. West was a member of the American Society of Mechanical Engineers, American Society for Testing Materials, American Association for the Advancement of Science, Civil Engineers' Club of Cleveland, and an honorary member of the Philadelphia Foundrymen's Association and also of the Pittsburgh Foundrymen's Association. He was president of the American Foundrymen's Association from June, 1905, to June, 1906, and for many years was one of its most active members.

In politics Mr. West was a staunch Republican and for several years was president of the Sharpsville Republican Club. At the end of the McKinley-Bryan campaign in 1896, he was presented a handsome gold cane by the Sharpsville Republicans and a library clock by the Sharon Republicans as a recognition of the valuable service he had rendered his party.

During his later years, Mr. West had devoted a large part of his time and energy to the prevention of accidents. In 1908, he organized the American Anti-Accident Association and later wrote numerous articles and pamphlets to promote the safety movement. His latest work along this line was as chairman of the committee of Ohio foundrymen, which has been working on the framing of rules and regulations for the promotion of safety and sanitation in foundries of that state. A few days before his death, Mr. West completed this work and was ready to present it for approval to the Ohio industrial commission. Owing largely to his efforts, the Ohio legislature recently made an appropriation to further safety work in Ohio. The industrial commission will receive $5,000 and an additional $5,000 will be available if the manufacturers of the state contribute a like amount.

Mr. West is survived by his widow and by three children, Dr. Thomas J. West, of Honolulu,; Ralph H. West and Mrs. William E. Ward, of Cleveland.

The following tribute to Mr. West is by Dr. Richard Moldenke, of Watchung, N. J.:

"It was a strange coincidence that while I was engaged in writing up the subject of repairing castings, and dwelt upon the first which was written by Mr. West (Jan. 15, 1881—on "burning-on" heavy castings), that the telephone should ring and word come of his tragic departure from this life. The shock brought home to me the fact that we had been close friends for nearly 24 years and had worked hand in hand to solve many problems in the modern foundry advance, of which Mr. West was the father.

"Back in the early days of my foundry life, while in Pittsburgh, and when Mr. West's activities were centered in Sharpsville, Pa., I spent many a Sunday with him and gained wisdom from his inexhaustible fund of foundry knowledge. Many of the elaborate series of tests he made, and at which I assisted from the laboratory end, were laid out at these meetings.

"He is now called away from his activities, much too soon for the good of the industry, but not too late to have experienced within his lifetime the rare satisfaction of achieving success, and seeing his work for foundry betterment accepted as authoritative the world over. He is recognized as the foremost authority on practical foundry procedure. A genial, optimistic, whole-hearted man and friend, full of sympathy toward his fellow men, but none the less ready to apply the surgeon's knife to the roots of inefficiency, self-indulgence, incapacity and carelessness he saw springing to engulf mankind. The modern movement for safety and efficiency owe much of their early progress to him —to his facile pen and constant and unremitting preachment.

"To record his services to the foundry world would fill many pages of the book on the modern foundry advance. His writings will be found in the transactions of all the engineering and technical societies of the world, and no man was his equal in the laying out of experimental details required in the study of his subject.

"Old and young, foundrymen the world over will mourn his loss. His amiable qualities will live long in their memories, and his constant striving after the truth will help to spur on others to do likewise. Truly of him can be said that 'his works live after him'."

Will Build Docks

Plans for a concrete municipal dock and steel warehouse at the Chain of Rocks, 10 miles north of St. Louis on the Mississippi river, have about been completed by the director of Public works of St. Louis.

The dock will be equipped with automatic machinery, and will be the first definite step the city has taken in control of municipal wharves and river terminals. The dock will be 2,000 feet long and 160 feet wide, and will be built on property owned by the city, a short distance from the waterworks plant.

Two other docks, one in the central part of the levee and one in the southern part of the city, will be built by the city to encourage river traffic. The municipal belt line will operate between the Chain of Rocks and the landing at the southern end of the city. Tracks of the Terminal Railroad Association also will be used.

Belgians Form Organization

Willy Lamot announces that several competent business men have formed an organization for a double object, to introduce in Belgium, as soon as the war is over, American products and manufactures, and to employ as agents, representatives, etc., a large number of Belgian manufacturers who have sustained heavy losses on account of the war, but still possess capital and can give the necessary guarantees. American manufacturers interested are asked to address Mr. Lamot at Shardhighs, Halstead (Essex), England.

New Mills for Youngstown Company

The Youngstown Sheet & Tube Co., Youngstown, has contracted with the Morgan Construction Co., Worcester, Mass., for one 9-inch continuous mill, one 12-inch continuous mill and one 14-18-inch continuous mill. All these mills are to be completed about April 1, of next year.

In addition to placing contracts for these mills, the Youngstown company expects to build two hand mills or jobbing mills, the sizes of which have not yet been decided upon; but they probably will be 10-inch and 16-inch mills. The company's plans for these additional mills provide for 9-inch, 10-inch, 12-inch and 14-18-inch continuous mills, four in all, and four hand mills, probably 8-inch, 10-inch, 16-inch and 20-inch. It is not likely all these mills will be erected for several years, but the company expects to add a mill at a time, as fair demand for the product develops and funds become available.

Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., which specializes in the manufacture of motor castings, would like to receive catalogs and literature along the lines of their manufacture and are especially interested in those pertaining to chemistry.

The Wayne Brass Foundry, Pittsburgh, has purchased property adjoining its present site, to provide additional space for storage and pattern shop buildings.

MEN OF THE IRON TRADE

Who they are Where they are What they are doing

Wm. A. Sproull, who has resigned as traffic manager of the Cambria Steel Co. to take charge Aug. 1 of the bureau of transportation and traffic of the chamber of commerce of Philadelphia, has been connected with the Cambria Steel Co. for 25 years. Before that, he was associated with the Great Northern; the Chicago, St. Paul, Minneapolis and Omaha; the Pennsylvania; the Buffalo, Rochester & Pittsburgh, and the Chicago & Alton railroads. He was appointed traffic manager of the Cambria company, Sept. 1, 1890, with offices at Philadelphia, where he remained until December, 1909, when he took charge of the traffic department at Johnstown. In December, 1912, when the general offices of the company were moved to Pittsburgh, Mr. Sproull went to that city. He was one of the organizers of the Traffic Club of Philadelphia, and was second president of that ogranization. A few days ago, Mr. Sproull was elected president of the Traffic Club of Pittsburgh, with which he has been actively identified the last three years.

Donald Tulloch, secretary of Worcester branch, National Metal Trades Association, of Worcester, Mass., has returned from a 10 days' trip to various states in search of machinists, being unable to secure any large number.

Arthur J. Wallace, general manager of the Economic Machinery Co., of Worcester, Mass., who has just returned from a trip through the west, makes the prediction that inside of 10 years the country will be practically prohibition.

W. C. Coffin, in charge of the structural engineering department of the Jones & Laughlin Steel Co., Pittsburgh, has been elected president of the General Alumni Association of the University of Pittsburgh, from which he was graduated in 1883.

J. B. Evans has become connected with the National Concrete Machinery Co., Madison, Wis., as general manager. Mr. Evans was formerly engineer of sales installations for the General Railway Signal Company of Canada, Ltd., Montreal.

Colonel Richard Coulter, of Greensburg, Pa., has been elected president of the Keystone Coal & Coke Co., to succeed the late L. B. Huff. F. B. Miller is treasurer; Henry Coulter, secretary, and J. B. Huff and R. K. Kassatt are vice presidents of the company.

James F. Webb has resigned as foreman of the foundry operated by the Davenport Locomotive Works, Davenport, Ia., and will devote his entire attention to the affairs of the J. F. Webb Mfg. & Supply Co., Davenport, manufacturer of molding machines.

S. W. Hartley, formerly sales manager of the Standard Welding Co., Cleveland, has been made manager of the production department. H. A. Flagg, formerly sales manager of the tubing department, has been appointed general sales manager and advertising manager.

WM. A. SPROULL

Fred P. Oliver, who has been associated with the iron and steel industry for about 20 years, and for the past five years has occupied the position of assistant to L. B. Morris, New York district sales manager of the Cambria Steel Co., has resigned to become vice president and general manager of the Blackman Talking Machine Co., of New York.

G. M. Crockett, of New Glasgow, N. S., is visiting the United States for the purpose of buying lathes for the manufacture of war machinery in Canada. He was able to pick up a few here and there in New England, but found it impossible to secure any large number on account of manufacturers having sold out their stocks and being unable to guarantee early deliveries on future orders.

W. C. Tharp has recently succeeded I. J. Shults, resigned, as district manager in charge of the Pittsburgh office of the Hoskins Mfg. Co., 453 Lawton avenue, Detroit, manufacturer of electric furnaces, pyrometers and heating appliances. Mr. Tharp was formerly associated with the Republic Iron & Steel Co., the Scientific Materials Co., and the Metallurgical Testing Laboratory, of Pittsburgh, and has a wide acquaintance in the Pittsburgh district.

C. H. Morse Jr., who has been elected president of the Fairbanks, Morse & Co., succeeding his father, C. H. Morse Sr., was graduated from the University of Michigan in 1895, as a mechanical engineer. He first entered one of the Fairbanks, Morse & Co. shops in order to get a practical knowledge of the building of gas engines, pumps, etc. He has been president of the Fairbanks, Morse Mfg. Co., Beloit, Wis., in charge of manufacturing, for 10 years.

H. L. Terwilliger has been appointed district manager of the Ingersoll-Rand Co., New York City, for the territory handled by the San Francisco and Los Angeles offices of that company. Mr. Terwilliger's headquarters will be at the branch office of the company, 139 Townsend street, San Francisco, recently opened. Harron, Rickard & McCone, who have been agents of the company, will cooperate with it in the sale of its machinery after the expiration of their agency contract on July 22.

Governor Brumbaugh, of Pennsylvania, last week signed the Lake Erie and Ohio river canal bills which provide for the continuance of the commission of five members and authorize counties to hold elections and vote on issuing bonds to help meet expenses. Ohio and West Virginia have laws authorizing them to cooperate with Pennsylvania and cooperation by the United States government is practically a certainty, according to members of the Pennsylvania commission.

Tool Prices Continue to Advance

Revival of Demand for Machine Tools Chiefly for England and Russia is of Special Interest—Domestic Market More Active at All Centers

IN LAST week's issue of *The Iron Trade Review* was published an announcement that the principal makers of lathes, turret lathes and automatic and hand screw machines again had advanced their prices by about 10 per cent, making the prices on such machines approximately 20 per cent higher than they were at the beginning of the year. During the past week the movement to advance prices on machine tools has become more general. The principal makers of milling machines have effected advances ranging from 10 to 15 per cent, and the makers of heavy duty, high speed drills have followed suit with an advance of approximately 10 per cent. It is understood that similar advances in the prices of other machine tools shortly will be declared effective.

Further buying of machine tools to manufacture munitions of war features the market in the east, although this buying is not on as large a scale as in the past. This, as previously reported, is due to the extent to which the machine tool dealers and manufacturers are sold ahead. In the east, the Bethlehem Steel Co., the E. W. Bliss Co. and the General Electric Co., all bought large quantities of equipment during the week. Several other concerns who are engaged on war contracts bought in a scattered way, and the business placed in this manner mounted up to a rather large total. Reports regarding companies who are figuring on war contracts continue to be heard. It is understood the Crocker-Wheeler Co., Ampere, N. J., now is figuring on such a contract. Of especial interest is the revival in the demand for machine tools for shipment abroad, mainly to England and Russia. One large interest says the demand from these countries for machine tools for making war munitions is fully as large as at any time since the outbreak of the war. While a large part of this business has been booked, the larger portion continues unplaced, due to the impossibility of getting the deliveries wanted.

Purely domestic demand for machine tools continues to show some improvement, but no one pretends this demand is anything like what may be considered as normal. Practically no purchases or inquiries by eastern railroads are noted. The Seubert Bearing Co., which has just located at 556 Jackson avenue, Long Island City, has purchased a good-sized quantity of machinery. The American Smelting & Refining Co., 165 Broadway, New York, is inquiring for a few tools, including a boring mill. Gerdes & Co., 30 Church street, New York, are in the market for a boring mill. Peter A. Frasse & Co., Sullivan and Canal streets, New York, are in the market for a few tools. C. K. Turner & Son, 116 Broad street, New York, are inquiring for a number of tools. Among eastern concerns which are extending their capacity are: The New London Ship & Engine Co., Groton, Conn.; the Bantam Anti-Friction Co., Bantam, Conn.; the Southington Mfg. Co., Southington, Conn.. the Carpenter Steel Co., Reading, Pa.; the Howe Scale Co., Rutland, Vt.; Heim Machine Co., Danbury, Conn.; Farrel Foundry & Machine Co., Ansonia, Conn.; Bosch Magneto Co., Springfield, Mass.; American Car & Foundry Co., Milton, Pa.; L. W. Pond Machine & Foundry Co., Worcester, Mass., and many others. The Pennsylvania railroad is believed at last to be ready to take bids on the new coal-handling plant at Canton, Md., which it has had under consideration for two or three years.

Important Industrial Undertakings Considered

The domestic market for machine tools and rolling mill equipment in the Greater Pittsburgh district rapidly is becoming more active. Several important industrial undertakings are under consideration and equipment dealers predict that the last half of the year will be fully as active as the first six months. The United States Steel Corporation, as announced elsewhere in *The Iron Trade Review,* has completed plans for a $3,000,000 plant at Donora, Pa., for the manufacture of spelter and by-products. Inquiries for equipment have not yet been sent out. The Youngstown Sheet & Tube Co., Youngstown, O., has definitely decided to enter the manufacture of bars and has awarded contracts to the Morgan Construction Co., Worcester, Mass., for one 9-inch continuous mill, one 12-inch continuous mill and a combination 14-inch and 18-inch continuous mill, and considerable other equipment will be purchased in the near future. The Standard Tin Plate Co., Cannonsburg, Pa., which has completed plans for increasing capacity, is negotiating for three 15-ton cranes, one 10-ton crane and one 20-ton crane. The McKeesport Tin Plate Co., McKeesport, Pa., probably will award contracts for nine electric cranes next week. The Allegheny Steel Co., Brackenridge, Pa., will enlarge its plant for the manufacture of a pressed steel side frame for steel cars and will erect three large buildings and will buy considerable new equipment. Directors of the Wheeling Steel & Iron Co., Wheeling, W. Va., are seriously considering plans for numerous improvements and extensions to its plants in the Wheeling district. Demand for lathes for the manufacture of war material continues unabated, although no large contracts for equipment have been placed in this district for some time.

Majority of Business is for Domestic Delivery

In Cincinnati, makers of machine tools are taking new foreign contracts very carefully, and are specifying that a sudden termination of the war will not make them invalid. It would be safe to say that more machine tools have been made in Cincinnati since the first of the year, than during any similar period in the history of the machine tool trade here. The majority of business being placed at present is for domestic delivery, as there is still a big demand out from American plants making munitions of war, and this business is much preferred above that for foreign shipment. The French government is inquiring in this market for a large number of lathes and milling machines, estimated to be almost 1,000 of each, and another inquiry from Italy calls for 500 lathes of the 14, 16, 18 and 20-inch sizes. These are not being given much consideration here, as they call for immediate deliveries, and shops are booked

Results Speak Louder Than Words

An installation of Ayer & Lord Interior Wood Blocks in the plant of the *Commonwealth Steel Company, Granite City, Illinois.*

This company manufactures huge *car truck frames.* The illustration is evidence that these blocks have to undergo the test limit in flooring service.

Besides the continual moving about of these immense steel castings, violent trucking must also be contended with.

The highly satisfactory results obtained by other manufacturers under other severe conditions proved to the Commonwealth Steel Company that Ayer & Lord Interior Wood Blocks would be indispensable to them.

Read What these Users Say:

"A year ago we floored one end of our mill with the Ayer & Lord Tie Company's Blocks with results that are entirely satisfactory. During the month of November we put down another section of the same material, which is *the best evidence that we are pleased with the blocks and the completed floor.*"

"Our flooring stood well under severe treatment and we highly recommend it for rolling mills or other factories where heavy weights are moved by trucks."

Ayer & Lord Tie Company

General Office: Railway Exchange, Chicago

CLEVELAND, OHIO, 926 Illuminating Building
MEMPHIS, TENN., 1402 Exchange Building
KANSAS CITY, MO., 1117 Rialto Building
PHILADELPHIA, PA., 319 Perry Building

to capacities for at least three or four months in advance.

Increase in Prices Effects Railroad Buying

Domestic demand for machine tools seems to be on the increase. To such a degree has this spirit been manifested in the Chicago market that buyers from the east and Canada are not receiving the consideration they formerly did. General machine shop operations seem to be improving and inquiries are being received from every direction for machines of every description.

War demand continues strong and a number of buyers from Canadian concerns have been in the city recently, but have found comparatively little equipment suited to their needs, as this has been picked up almost as fast as it could be obtained. Even second-hand material which has seen hard use is being sought. Demand for milling machines, which are produced slowly, because of their size, has cleaned up most of the makers in the west and an advance in price is expected shortly. Strong demand is being felt now for turret lathe equipment to make over machines not wholly suited to the purpose to which they are to be devoted, mostly turning shrapnel. A Minnesota steel and machinery company has taken considerable orders for tractors which probably will be shipped to foreign users. Another new demand is for small turrets suitable for turning brass materials, which are not as heavy as those used for steel. A large builder of typewriters in Illinois is said to have taken considerable business manufacturing small parts for shells, its machinery being particularly suited to this purpose. Deliveries from machine tool builders are difficult and many sellers are devoting much of their time to watching manufacturers for fear machines may be delivered to others who are exerting more pressure.

The Santa Fe railroad has closed for a few lathes, less than one-half dozen, on its recent list, but has withdrawn the remainder of the inquiry and is said to be definitely out of the market. This decision is said to have followed the recent price increase, which has made machines too costly for railroads to buy except such as they absolutely need. The Burlington is believed to be held back by much the same reason.

EASTERN STATES

SOMERSVILLE, MASS. — David Houston has purchased from Myer Dana property on Jaques street and will erect a plant for manufacturing automobile tops.

WORCESTER, MASS.—Worton Co. is adding a $5,000 blacksmith shop to its works at Greendale, Mass., to be used as a heat tempering plant by the Norton Grinding Co.

HARTFORD, CONN.—Colt Patent Fire Arms Mfg. Co. has received a $10,000,000 contract for rapid fire guns for the British government, which will keep the plant busy for at least two years.

MERIDEN, CONN.—Edward Miller Co. is about to enter upon a contract for shrapnel cases with the French government of sufficient size to keep the plant busy for two years. Considerable new machinery will be installed.

NEW BRITAIN, CONN.—Union Mfg. Co. has let a contract for the erection of a 5-story building, 50 x 160 feet.

NEW HAVEN, CONN.—New Haven Pulp & Board Co. is to erect a large plant in New Haven, consisting of a 46 x 290-foot machine shop and other buildings.

NEW LONDON, CONN.—Sheffield Dentifrice Co. has let contract for a 2-story and basement, 55 x 85-foot plant.

WATERBURY, CONN. — Buckley Welding Co. has been incorporated; $10,000 capital stock; by Edward M. O'Brien, William A. Buckley and Francis J. Quinn.

WOONSOCKET, R. I.—Eastern Construction Co. is erecting a 3-story, 32 x 140-foot, brick storehouse for the Taft-Pierce Mfg. Co., manufacturer of special machinery.

BROOKLYN.—Equity Iron Works has been incorporated; $20,000 capital stock; by Charles Dipple Jr., Brooklyn; Targeir Omdal, New Rochelle, N. Y., Edgar R. Kraetzer, Jersey City, N. J.

BROOKLYN. — Sperry Gyroscope Co. has purchased a site on the west side of the Flatbush avenue extension, between Concord and Chapel streets, and will erect a 10-story concrete building, in which the Gyroscope company will occupy about 100,000 square feet.

JAMESTOWN, N. Y.—Gurney Ball Bearing Co. will take bids within a few months for the construction of a new factory to contain about 45,000 square feet of floor space.

NEW YORK.—American Smelting & Refining Co., 165 Broadway, is in the market for a boring mill and a few other tools.

NEW YORK.—Gerdes & Co., 30 Church street, are in the market for a boring mill.

NEW YORK.—C. K. Turner & Son, 116 Broad street, are inquiring for a number of machine tools.

NEW YORK.—Peter A. Frasse & Co., Sullivan and Canal streets, are inquiring for a few tools.

NEW YORK.—Triton Marine Construction Co. has been incorporated; $10,000 capital stock; by W. L. Ruppert, W. W. and C. E. Werbach, 500 Isham street.

NEW YORK.—Miller Centrifugal Motor Co., has been incorporated; $600,000 capital stock; by E. Ullman, M. Lippman and E. L. Meyer, 108 West 141st street.

NEW YORK.—International Arms & Fuse Co., munitions of war, has been incorporated; $1,500,000 capital stock; J. A. McCann, J. A. Harris and G. Arents Jr., 200 Fifth avenue.

CANNONSBURG, PA.—Standard Tin Plate Co., which has completed plans to increase capacity, has sent out inquiries for five cranes, three of which are to be of 15-tons capacity, one of 10-ton and one of 20-ton capacity.

CHESTER.—The Chester plant of the newly organized Kansas Tire & Tube Co. will be enlarged; Philip Freshwater is general manager.

DONORA, PA.—United States Steel Corporation has completed plans for the erection of a $3,000,000 plant for the manufacture of spelter and by-products.

GREENSBURG, PA.—Rinehart Bros., East Liverpool, O., have been awarded the contract for a steel bridge across Big Sewickley Creek at $75,000.

HARRISBURG, PA.—Harrisburg Pipe & Pipe Bending Co. has commenced work on the erection of three 1-story buildings.

NEWCASTLE, PA. — County commissioners recommend the construction of a new bridge over Heshannock creek at Jefferson street.

PHILADELPHIA.—American Ice Co. will erect a 121 x 361-foot ice plant.

PHILADELPHIA.—W. J. McCahan Sugar Refining Co. is taking bids on the construction of a 6-story sugar refinery, 64 x 78 feet, with a wing 64 x 64 feet, to be located at Tasker street wharf, Delaware river.

PITTSBURGH.—The department of charities has accepted Thomas Reilly's bid of $251,900 for the erection of an asylum for males at Marshalsea.

PITTSBURGH.—The contract for a double-deck stock pen on Herrs Island for the Pennsylvania railroad has been awarded to the Bailey & Lush Co., Philadelphia, at $150,000, according to reliable reports.

PITTSBURGH.—Brakeless Staybolt Co. has been incorporated with a capital of $300,000 to manufacture and sell copper, steel, coal, iron, timber, etc.; Incorporators are Robert J. McKay, J. Albert, and Thomas J. McKay.

PITTSBURGH.—Allegheny Steel Co. has completed plans for the erection of four buildings, one 90 x 126 feet, one 60 x 120 feet and two 30 x 135 feet, for the manufacture of a pressed steel side frame for steel cars; considerable new equipment will be installed.

PITTSBURGH.—Pittsburgh Steel Car Co., recently mentioned as having purchased 100 acres at Greensville, Pa., for the erection of a plant with a yearly capacity of 7,500 steel freight cars, soon will be in the market for necessary equipment. W. C. Scott, 511 Ferguson building, secretary, is in charge of the proposed undertaking.

READING, PA.—Reading railway proposes to erect a repair shop which probably will be equipped with electric cranes.

SHARON, PA.—A large manufacturing concern is said to have taken an option on a large tract of land near Hubbard, O., where it will be possible to draw a water supply from the new dam near Coalburg and Brookfield Center.

SOUTH BETHLEHEM, PA. — Bethlehem Steel Co. will start at once on the erection of another $60,000 shell-loading factory.

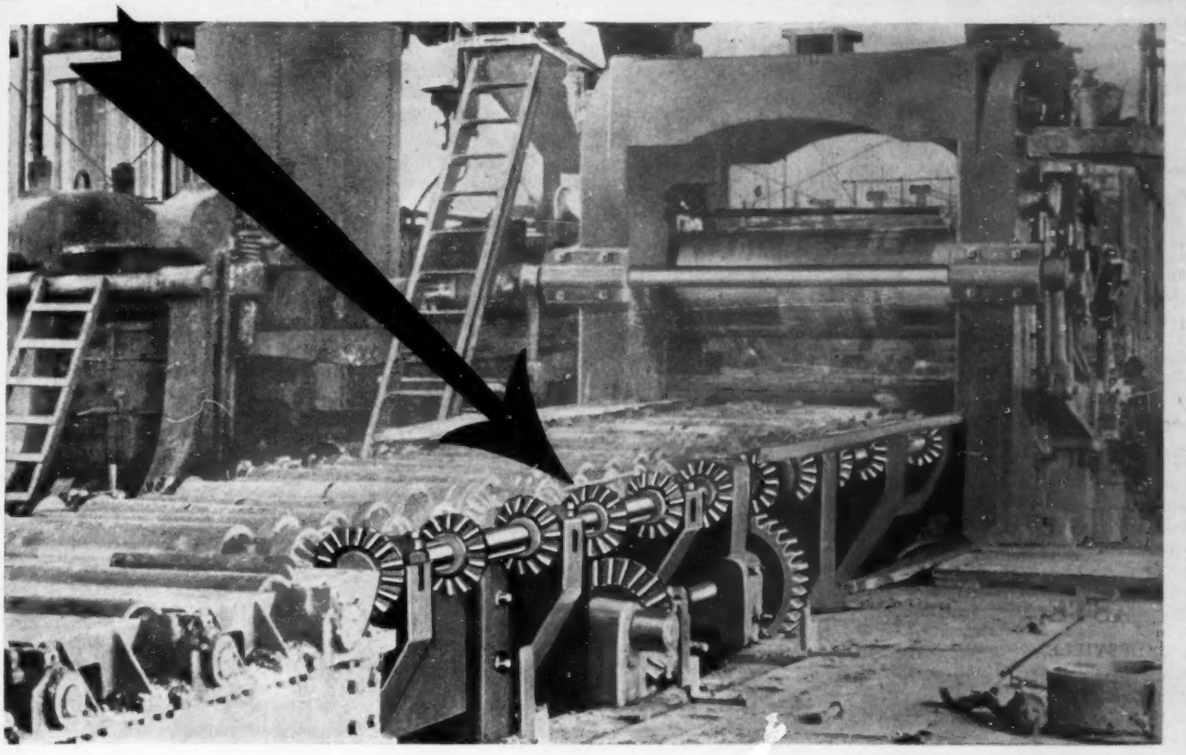
AMPERE, N. J.—Crocker-Wheeler Co. is understood to be figuring on a war contract.

ATHENIA, N. J.—Richardson Scale Co. will erect a 1-story, 60 x 150-foot building. The engineer, Elwyn E. Seelye, 101 Park avenue, New York, has plans in progress.

ATLANTIC CITY, N. J.—Medford Renneck Co. will replace the old wooden structure on the seaside route with a $78,000, steel structure.

BAYONNE, N. J. — Jacob Blumberg Co., hardware, manufacturer, has been incorporated; $42,500 capital stock; Aaron, Samuel and Jacob Blumberg, all of Bayonne.

IRVINGTON, N. J.—Essex Tire Construction Co. has been incorporated to manufacture automobile tires; $125,000 capital stock; by William Barth, Madison, N. J.; Frank H.



Do you know that you can make your rolling table gears last three times as long?

No! Well, it's being done by a number of the biggest mills in the Ohio Valley.

How? By "INFUSOING" which —

Increases tensile strength 100 per cent
Increases life of gears 300 to 400 per cent
which means—
Greater efficiency
Greater economy
One set of gears instead of three, saving two thirds the expense, delay and inconvenience of shutdowns to put on new gears.

We are "INFUSOING" gears, pinions, forgings, couplings, spindles, shafts and heavy duty parts of all kinds for a number of the largest steel plants.

Anything made of steel — large or small — can be "INFUSOED".

For one Cleveland gear cutting company we "INFUSO" an average of 19,088 pieces per month.

Ask us to tell you what we have accomplished for others.

Find out now what we can do for you.

Write us today about the equipment you want to wear longer and we will tell you by return mail what "INFUSOING" will do for you.

Steel Improvement Company

5003 Windsor Ave., Cleveland

Butterthworth and Fred M. Mervin, both of Irvington.

JERSEY CITY, N. J. — LaBelle Co. has been incorporated to manufacture electrochemical products; $100,000 capital stock; by Joseph Krieg, Anna Krieg and Augusta Gerhardtz, all of Jersey City.

JERSEY CITY, N. J.—Board of freeholders will receive bids until July for the erection of a $500,000 courthouse; also on that date for a $10,000 bridge at Belleville, N. J.

NEWARK, N. J.—Dirigold & Metals Co. has been incorporated to mine and manufacture; $150,000 capital stock; by Russell S. Davis, Newark; Carl Nelsen, Newark, and George H. Hinnan, New York.

NEWARK, N. J.—Mfg. & Sales Co. of the Float-Jet Carburetor has been incorporated to manufacture carburetors; $300,000 capital stock; by Siegfried Leschinger, Charles F. Kraemer, James M. Reilly, all of Newark.

NEWARK, N. J.—Tenison Supply Co. has been incorporated to manufacture mill supplies; $25,000 capital stock; by Edward W. Bechler, Newark; Claude H. Rivers and Henry Hopkinson, both of Elizabeth, N. J.

DOVER, DEL.—Motor Kart Mfg. Co., Inc., of New York, has been incorporated in Delaware; $500,000 capital stock; by Alfred R. Gormley, E. Maxwell Moore, New York; Herbert J. Sweenson, Montclair, N. J.

WASHINGTON.—Sealed proposals will be received at the office of the general purchasing officer, the Panama Canal, until August 16, for 12 electric towing locomotives for the canal locks; F. C. Boggs, major, Corps of Engineers, is general purchasing officer.

CENTRAL STATES

AKRON, O.—Jahant Heating Co. is erecting a $30,000 foundry on Falor street and expects to have it ready within a month.

ATHENS, O.—Athens Electric Co. has increased its capital stock from $10,000 to $75,000.

ATHENS, O.—Central Electric Producing Co. has been incorporated; $300,000 capital stock; by H. D. Manington, O. E. Harrison, H. C. Allread, E. H. Davis and H. H. Schweinsberger.

CANAL DOVER, O.—Mybro Heating & Mfg. Co. has increased its capital stock from $1,000 to $60,000.

CANTON, O.—C. L. Stoner, clerk of county commissioners, will receive bids till July 7 for the superstructure of a bridge in Perry township.

CANTON, O.—Victor Specialty Co., Canton, has purchased the Carrollton Novelty Co., Carrollton, O., for $40,000 and will manufacture sheet metal and cast iron toys, employing about 100 persons.

CINCINNATI.—Biskett Machine & Mfg. Co. has increased its capital stock from $10,000 to $40,000.

CINCINNATI.—Wm. Koehl & Co., Jamestown, N. Y., has let a contract for a 4-story and basement, 100 x 100-foot plant, to be erected on Hulbert avenue.

CINCINNATI.—Reliance Iron & Coke Co. has been incorporated; $25,000 capital stock; by Julius Fleischman, Alfred Knight, Albert E. Leen, Herbert Black and Irwin Davis.

CINCINNATI. — Commissioners have approved plans for a number of bridge and road improvements, on which bids immediately will be advertised.

CINCINNATI.—A new viaduct, involving several hundred tons of structural and reinforcing steel, will be built connecting Eden and Park avenue.

CINCINNATI.—Master Cutter Machine Co. has been incorporated with a capital stock of $20,000, by Morris V. Bernheim, E. Palmer Bernheim, R. DeV. Carroll, W. W. Cope and Jessee Lowman. The company advises that no equipment will be required.

CINCINNATI.—Globe Automatic Sprinkler Co. has increased its capital stock from $1,000,000 to $2,000,000.—No new equipment will be purchased as the additional capital will be used principally to expand the selling organization of the company.

CLEVELAND. — Loomis Construction Co. has been incorporated; $10,000 capital stock; by Wallace I. Knight, A. L. Bishop, E. G. Gilbert, A. B. Loomis and A. B. Loomis Jr.

CLEVELAND.—D. F. Sherbondy will erect a $10,000, 2-story light manufacturing building at 7,500 Quincy avenue, providing for 7,000 square feet of space.

CLEVELAND.—Plans for the new plant for the Frantz-Premier Co., manufacturer of vacuum cleaners, call for a 4-story, 60 x 320-foot main building, a foundry and a power plant; bids have been taken.

CLEVELAND.—Cleveland Motorcycle Mfg. Co., recently incorporated with $100,000 capital stock; has not decided whether to build a plant or lease adequate quarters. M. P. Mooney, Cleveland, is attorney for the company.

CLEVELAND. — Cleveland Worm & Gear Co., formerly at 990 East Sixty-seventh street, has taken a 5-year lease on the 3-story plant at Payne avenue and East Fortieth street, containing about 40,000 square feet of floor space.

CLEVELAND. — Westinghouse Electric & Mfg. Co. has taken out a $100,000 permit for additions and alterations which will cost when completed about $500,000. An 8-story fireproof pattern and storage plant already has been erected. Preparations now are being made for a big foundry addition.

CLEVELAND.—Plans have been completed by W. R. McCormack, architect for the board of education, which call for the erection of a 5-story, stone high school of commerce and administration building, estimated to cost about $1,000,000. A joint committee of citizens and board members will consider plans and the exact downtown location shortly.

COLUMBUS, O.—Franklin Lead & Zinc Co. has been incorporated; $10,000 capital stock; by William Siedensticker, G. L. Stephan, S. D. Schneider, W. N. Squires, Leonard Mohr.

DAYTON, O.—Morgan Engineering Co. will prepare plans for the Fifth street bridge, which probably will be erected as the result of the investigation committee's recent report.

HAMILTON, O.—Herring-Hall-Marvin Safe Co. will erect a $40,000 addition. Elmer E. Watson is resident supervisor.

LORAIN, O.—Service Director Lewis is expected to advertise for bids on a light and power contract for the city and for private consumers. If they are not satisfactory the council probably will go ahead with plans to vote on $350,000 bonds for the erection of a municipal power plant.

MT. VERNON, O.—Arnold Merkel, Cincinnati, representing a company recently organized to take over a spring wheel and backed by Dowling & Co., an investment firm of Cincinnati, desires to raise $6,000 in Mt. Vernon and $12,000 elsewhere for the location of a plant in Mt. Vernon. The original plant at Elkhart, Ind., went into the hands of a receiver and later was badly damaged by fire, about $25,000 worth of equipment being saved.

NEW PHILADELPHIA, O.—Ohio Service Co. has awarded contract to W. C. Handshy & Son, Zanesville, the contract for a power plant.

NEW PORTAGE, O.—Semi-Steel Foundry Co. has been incorporated; $10,000 capital stock; by Herman Peterson, Gustav A. Schwartz, A. S. Herdman, M. H. Behncke and E. P. Brown.

TROY, O.—Star Foundry Co. has been incorporated; $10,000 capital stock; by W. P. Anglemyer, Arthur Lockwood, Jacob Lust, J. M. Berman and J. C. Fullerton Jr.

HUNTINGTON, W. VA.—The chamber of commerce, C. P. Snow, president, has appointed a committee to prepare plans for a $475,000 bridge across the Ohio river.

WHEELING, W. VA.—Estimates on the proposed well water filtration system have been completed by city engineer, C. B. Cooke, who recommends the use of centrifugal pumps and a 5,000,000-gallon storage reservoir.

WHEELING, W. VA.—Directors of the Wheeling Steel & Iron Co. are seriously considering numerous improvements and extensions to plants of the company in the Wheeling district.

FT. THOMAS, KY.—The city council Winston Ross, secretary, is preparing to award franchises for the operation of a water system and electric light plant.

HARLAN, KY.—W. E. Hunter, Elizabethtown, Tenn., has organized a company to install a water system. An ice plant also may be established. The total investment will be $50,000.

JACKSON, KY.—J. W. Dean is in the market for a second hand steam road-roller, oil sprinkler and other road building machinery. An eight or 10-ton roller is desired.

KEWANEE, KY.—Kewanee Coal Mining Co. is planning to install power equipment, including boiler, engine, generator, etc.

LAWRENCEBURG, KY.—County commissioners will build a bridge over the Whitewater river at Longnecker station.

LEXINGTON, KY. — J. P. Donnovan, Georgetown, Ky., will establish a plant in Lexington for the manufacture of a patented steel railroad tie.

LOUISVILLE, KY.—McQuire & Comstock Machine Co. has changed its name to the Louisville Elevator & Machine Co. Louis W. Zettler is manager.

LOUISVILLE, KY.—B. & B. Ice & Coal Co., capitalized at $30,000, is purchasing equipment for an ice plant at Fourteenth and Ormsby streets; address Claude N. Boone.

OWENSBORO, KY.—Southern Foundry Co. is planning to manufacture shrapnel.

EVANSVILLE, IND.—Mead, Johnson & Co., Jersey City, N. J., have completed plans to remove their plant to Evansville, and will remodel a mill building which has been leased for their use.

KOKOMO, IND. — County commissioners have passed an appropriation of $17,000 for a bridge in Ohio street.

LIBERTY, IND. — W. F. Bissert, county auditor, is about to sell $15,000 bonds for the erection of a bridge over Whitewater river at Brownsville, Ind.

MT. VERNON, IND.—J. R. Haines, county auditor, will take bids about July 1 on several steel and concrete bridges.

NORTH LIBERTY, IND.—A corporation with $14,000 capital stock with the city as the chief stockholder is being formed to establish a water works plant.

PORTLAND, IND. — McLaughlin & Hulsken, architects, Lima, O., have made preliminary plans for a 3-story courthouse, 90 x 160 feet, costing $275,000.

CHICAGO.—American Pattern & Metal Co. 2059 Walnut street, has increased its capital stock from $10,000 to $12,000.

CHICAGO.—Marshfield Lamp & Brass Mfg. Co. has been incorporated to manufacture brass devices; $10,000 capital stock; by Czeslaw Gronczewski, Alexander Hinckleman and Zygmund J. Odsoki.

CHICAGO.—Laboratory Metal Goods Co. has been incorporated with a capital of $1,000

Thomas P. Octigan, 105 West Monroe street, may be addressed.

CHICAGO.—R. M. Hvid & Co., 86 South Dearborn street, manufacturers of gasoline engines, have incorporated with a capital stock of $50,000.

GALENA, ILL.—G. W. Landreth & Co. have bought the Old Cyclone mine near Galena and will remodel the plant, installing modern machinery to operate on a larger scale.

QUINCY, ILL.—Michaelman Steel Construction Co., Second and Hampshire streets, is building an $8,000 addition, two stories, 109 x 133 feet.

SPARTA, ILL.—Board of local improvements will ask bids soon on a water works plant to cost $60,000. W. McK. Brown, East St. Louis, Ill., is engineer.

SPRINGFIELD, ILL.—J. C. Kerst is having plans made for a factory to manufacture auto farm machinery.

DETROIT.—Auto Crank Shaft Co., J. M. Hubbard, general manager, is erecting an addition to its foundry on Pioquette avenue, to cost $10,000.

DETROIT.—Plans are being prepared by A. A. Albrecht Co. of Detroit for a $25,000 reinforced concrete addition for the Detroit Screw Works.

DETROIT.—Detroit Edison Co. has applied to the state railway commission for permission to make a $75,000,000 mortgage of which about $60,000,000 will be used for future improvements.

DETROIT. — Pronovost Torsion Spring Wheel Co. has been incorporated to manufacture torsion spring wheels for motor vehicles; $50,000 capital stock; by Joseph Pronovost, Herbert Pronovost and George H. Ropes.

DETROIT.—Atlas Foundry Co., Robert Crawford, president, has awarded contract to the Wisconsin Bridge & Iron Co., Milwaukee, for the erection of a 85 x 270-foot addition, of steel frame construction at Artillery avenue and the Wabash railroad. The plant, which is to be ready in September, is to handle increased business.

JACKSON, MICH.—Benjamin Briscoe of the Brisco Motor Co., organizer of the Maxwell and French Brisco companies, has purchased two farms near Jackson and will erect factories for the manufacture of the new Argo moderate priced car at the rate of 10,000 to 20,000 annually.

PORT HURON, MICH.—County commissioners will build a $15,000 bridge over Pine river.

THREE RIVERS, MICH.—George Champe, engineer, Toledo, O., is preparing plans for a municipal light and water plant for which citizens have voted $50,000.

BEAVER DAM, WIS.—Klipper Mfg. Co. has been organized at Beaver Dam, Wis., by R. P. Scholz and N. Schweiger to manufacture a general line of brass, bronze and aluminum products. The new company takes over the business of E. O. Siedschlag & Co., East Third street, Beaver Dam, having purchased the major interest of E. O. Siedschlag. Some improvements are contemplated, but no important extensions will be made at this time.

CARROLLVILLE, WIS.—United States Glue Co. is having plans prepared by Herman J. Esser, Milwaukee, for a 1-story, 154 x 365 foot factory building and a 2-story 205 x 225-foot warehouse, both to be added to its plant this year. W. G. Hanson is general manager.

GREEN BAY, WIS.—Walter F. Gerald, has organized the Badger Welding & Cutting Co. and has opened quarters in Green Bay.

GREEN BAY, WIS.—Automatic File & Index Co., manufacturing fireproof and fiber office material, is building a 37 x 40-foot addition to its plant for finishing and stock rooms. Upon the completion of this addition, another wing, 30 x 48 feet, will be undertaken.

GREEN BAY, WIS.—East River Iron & Brass works has been leased by Theodore and A. Helgerson, who will conduct the business under the name of the Helgerson Bros. Iron Works.

KENOSHA, WIS.—Board of water commissioners will soon award contracts for the construction of a new lake intake, crib, pumping station and shore tunnel to Washington island, costing approximately $160,000. The intake and shore tunnel will require about 10,000 lineal feet of 42-inch cast iron pipe. Plans and specifications have been prepared by B. C. Brennan, superintendent of waterworks.

LA CROSSE, WIS.—It is reported the Wisconsin-Minnesota Light & Power Co., with headquarters in La Crosse, will spend about $48,000 in reconstructing its heating system and distribution lines.

MADISON, WIS.—John T. Blake, Madison, was awarded the general contract for the erection of the new branch house of the J. I. Case Threshing Machine Co., Racine, Wis., in Madison. It will be 100 x 140 feet in size and contain a complete service shop, garage and parts stock for the accomodation of the western Wisconsin territory, which this branch covers. C. C. Doring is local manager.

MILWAUKEE, WIS.—The plant of the Western Fixture Co., recently burned with $10,000 loss, will be rebuilt at once.

MILWAUKEE.—A. D. Koch, architect, is taking bids for the erection of a $250,000, 10-story, steel and concrete office building.

MILWAUKEE.—E. H. Harbach, Tenth and Prairie streets, secretary of the board of education, is preparing to erect a brick and concrete fireproof 1-story boiler house addition; 36 x 75 feet, cost $15,000.

MILWAUKEE.—North End Foundry Co., Sixtieth avenue, West Allis, which erected a new plant upon its removal from North Milwaukee about eighteen months ago, is erecting an addition to its plant to take care of increased orders. The new building will be of brick and steel construction, 60 x 80 feet, one story, and the work is in charge of Klug & Smith, consulting engineer, Mack block.

RICHLAND CENTER, WIS.—Prouty Automobile Co. is erecting a 44 x 126-foot addition to its garage, to be used as a repair shop and auxiliary storage.

WAUSAU, WIS.—The general contract for erecting a $250,000 cold storage, warehouse and meat packing plant for the Wausau Farmers' Co-operative Packing Co. has been awarded to F. W. Krause, Wausau, by Chicago architects in charge of the project. It is expected the plant will be ready by Nov. 1. Contracts for the equipment are now being made.

WESTBY, WIS.—This village has voted to issue $30,000 bonds for a number of combined projects, including a municipal electric light and waterworks plant, village hall, library and auditorium. The pumping station and power plant will be 45 x 70 feet. The village has engaged E. E. Dillon, architect and consulting engineer, 1039 University avenue, Madison, Wis., to supervise the work.

FT. MADISON, MO.—D. L. Davis Co., manufacturer of a tire inflator, is reported to be planning the erection of a large plant in Ft. Madison.

KANSAS CITY.—Bonds for $450,000 have been voted for bridges and viaducts. Henry J. Yost is mayor.

MACON, MO.—Macon Machine Co. has been incorporated and will equip a manufacturing plant; $25,000 capital stock; Harry Huncker, W. D. Coulter and W. G. Miller; incorporators.

ST. LOUIS.—Philip A. Rohan Boat, Boiler & Tank Co. has been incorporated; $25,000 capital stock; by S. H. Rohan, W. F. Fahey and S. H. Rohan.

ST. LOUIS.—Tytnot Machine Co. has been incorporated to manufacture package wrapping and typing machine; $18,000 capital stock; by Henry H. Brockman, Ray W. Brockman and Frederick Demko Jr.

Gladdest for Saddest

"It might have been."

Yes—

These are sad words, and would they not have appeared less often in the category of business, if only—

The right hunch had been given at the right time?

But to break away from this gloom—

Your attention, Mr. Sales Manager, is called to some right-time hunches, preluded as follows:

"The 'gladdest' words of tongue or pen, as in the days of yore,

Simply is this little phrase: 'We're in the market for—'"

C. K. Turner & Sons, 116 Broad street, New York City, are in the market for a number of machine tools.

Gerdes & Co., 30 Church street, New York City, are in the market for a boring mill.

American Smelting & Refining Co., 165 Broadway, New York City, is in the market for a boring mill and a few other tools.

Peter A. Frasse & Co., Sullivan and Canal streets, New York City, are in the market for a few tools.

Pittsburgh Steel Car Co. soon will be in the market for equipment for its proposed plant at Greensville, Pa.

Standard Tin Plate Co., Cannonsburg, Pa., is inquiring for five cranes, three of which are to be 15-tons capacity, one of 10-ton and one of 20-ton capacity.

Edward C. Miller, Meriden, Conn., is about to enter into a contract for a large shrapnel contract and will install a considerable amount of new machinery.

Allegheny Steel Co., Brackenridge, Pa., has completed plans for the erection of four buildings for the manufacture of a steel side frame for steel cars and will install a considerable amount of new equipment.

IRON AND STEEL PRICES

Corrected up to Tuesday noon

PIG IRON

(Delivery to July 1.)

Bessemer, valley	$13.65 to 13.75
Bessemer, Pittsburgh	14.60 to 14.70
Basic, Pittsburgh	13.60 to 13.75
Basic, eastern Pa.	13.75 to 14.00
Malleable, Pittsburgh	13.45 to 13.95
Malleable foundry, Chicago	13.00
Malleable foundry, Philadelphia	15.00 to 15.25
Malleable foundry, Buffalo	12.50 to 13.00
No. 1X foundry, Philadelphia	14.50 to 14.75
No. 2 foundry, Pittsburgh	13.45 to 13.95
No. 2 foundry, valley	12.50 to 13.00
No. 2 foundry, Cleveland	13.00
No. 2 foundry, Ironton	12.50 to 12.75
No. 2 foundry, Chicago	13.00
No. 2X foundry, Philadelphia	14.25 to 14.50
No. 2X fdy., N. J. tidewater	14.25 to 14.50
No. 2X foundry, Buffalo	12.50 to 13.00
No. 2 plain, Philadelphia	14.00 to 14.25
No. 2 plain, N. J. tidewater	14.00 to 14.25
No. 2 plain, Buffalo	12.25 to 12.50
No. 2 southern, Birmingham	9.50 to 10.00
No. 1 southern, Cincinnati	12.40 to 12.90
No. 2 southern, Chicago	13.50 to 14.00
No. 2 southern, Phila. delivery	14.00 to 14.25
No. 2 southern, Cleveland	13.50 to 14.00
No. 2 south'n, New York docks	13.75 to 14.00
No. 2 southern Boston, docks	13.75 to 14.00
No. 2 south. interior, New Eng.	14.50 to 15.50
No. 2 southern, St. Louis	12.90 to 13.40
Virginia No. 2X furnace	12.50 to 13.00
Virginia 2X, Philadelphia	15.25
Virginia 2X, Jersey City	15.50
Virginia 2X, Boston points	15.75
Gray forge, eastern Pa.	13.25 to 13.50
Gray forge, Pittsburgh	13.20
Gray forge, Birmingham	8.75 to 9.00
Silveries, 8 per cent, Jackson, O.	14.75 to 15.25
Silveries, 5 per cent Birmingham	12.50
Silveries, 5 per cent, Chicago	16.35
Standard low phos., Phil.	20.00 to 21.00
Lebanon low phos., furnace	16.00 to 16.50
Low phos., Pittsburgh	20.95 to 21.20
Charcoal, Lake Superior, Chgo., Nos. 1 to 4	15.25 to 16.25
Charcoal, Buffalo	15.75 to 17.00
Charcoal, Birmingham	21.00

IRON ORE

Lake Superior Ores.

(Lower lake ports.)

Old range Bessemer, 55 per cent	$3.75
Mesabi Bessemer, 55 per cent	3.45
Old range, non-Bess., 51½ per cent	3.00
Mesabi non-Bessemer, 51½ per cent	2.80

FOREIGN ORES

(Per unit Philadelphia.)

(Prices nominal.)

Foreign Bess., 50 to 65 per cent	8 to 8½c
For'n non-Bes., 50 to 65 per cent	8 to 8½c

COKE

(At the ovens)

Connellsville furnace	$1.55 to 1.60
Connellsville fur. contr	1.65 to 1.75
Connellsville furnace coke, fourth quarter	1.75
Connellsville foundry	2.00 to 2.40
Connellsville fdy. contr	2.25 to 2.50
Wise county furnace	1.75 to 2.00
Wise county foundry	2.25 to 2.50
Pocahontas furnace	1.75 to 2.00
Pocahontas foundry	2.00 to 2.25
New River, foundry	2.50 to 3.00
New River, furnace	2.00 to 2.25

FERRO-ALLOYS

Ferro mang. furnace (prompt)	$115
Ferro mang. Balti. (future)	$95.00 to 100.00
Ferro-silicon, 50 per cent, Pbgh.	71.00 to 73.00
Ferro-silicon, 50 per cent, Phila.	71.00 to 73.00
Ferro-sil., 12 to 13 per cent	18.00 to 18.50
Ferro-sil., 11 to 12 per cent	17.00 to 17.50
Ferro-sil., 10 to 11 per cent	16.00 to 16.50
Ferro-sil., 9 to 10 per cent	15.00 to 15.50

(Ferro-silicon quoted at furnace Ashland, Jackson and New Straitsville.)

Ferro-carbon titanium, carloads, per lb.	8c to 12½c

SEMI-FINISHED STEEL

Open hearth billets, Phila	$22.06 to 22.56
Forging billets, Phila	24.56 to 25.06
Forging billets, Pbgh	25.00 to 26.00
Wire rods, Pittsburgh	$25.00 to 26.00
Billets, Pittsburgh	20.00 to 21.00
Billets, Youngstown	19.00 to 20.00
Sheet bars, Pittsburgh	20.50 to 21.50
Sheet bars, Youngstown	19.50 to 20.50
Muck bar, Pittsburgh	27.00

Freight Rates via Panama Canal

Rates on finished materials, including plates, shapes, bars, wire, nails, etc., to Pacific coast points via Panama canal, per 100 lbs., in carload lots, exclusive of insurance and dockage.

From New York	$0.45
From Pittsburgh	.619
From Youngstown	.639
From Niles	.619
From Wheeling	.619
From Steubenville	.619
From Johnstown	.604
From Coatesville	.545
From Steelton	.555
From Bethlehem	.529
From Cleveland	.65
From Chicago	.765

RAILS AND TRACK MATERIAL

Stand. Bess., rails, Pbgh	1.25c
Stand. open-hearth rails, Pbgh	1.34c
Lgt. rails, 8-lbs., Pbgh. & Chgo.	1.22c
Lgt. rails, 12 lbs. Pbg. & Chgo.	1.17c
Lgt. rails, 16 to 20 lbs., Pgh. & Chgo.	1.12c
Lgt. rails, 25 to 45 lbs., Pbgh. and Chgo.	1.07c
Relaying rails, standard, Pbg. & Chgo.	$23.00 to 24.00
Relaying rails, light, Chgo.	21.50 to 22.50
Angle bars, st. sect. Pbgh. base.	1.50c
Angle bars, st. sections, Chicago	1.50c
Spikes, railroad, Pbgh	1.35c to 1.40c
Spikes, railroad, Chgo	1.50c
Track bolts, Pbgh	1.90c to 2.00c
Track bolts, Chgo	2.00c

Freight Rates, Pig Iron

Mahoning and Shenango valleys to:—	
Cleveland	$0.95
Newark, N. J	3.00
New England	3.00
Philadelphia	2.79
Pittsburgh	.95
St. Louis	3.18
Buffalo to:—	
Albany, N. Y	$1.26
New England (all rail)	2.58
New York and Brooklyn (all rail)	2.58
New York and Brooklyn (by canal)	1.00 to 1.50
Virginia furnaces to:—	
Boston docks (r. and w.)	$3.05
New England (all rail)	3.25
New York dock (r. and w.)	2.88
Birmingham, Ala., to:—	
Cincinnati	$2.90
Chicago	4.00
Cleveland	4.00
Louisville, Ky.	2.65
New York (all rail)	6.15
New York (rail and water)	4.25
Philadelphia (all rail)	5.20
Philadelphia (rail and water)	4.00
Pittsburgh	4.90
Savannah, Ga.	2.75
Chicago, to:—	
Des Moines	$2.80
Milwaukee	.50
Moline, Ill.	1.47
Omaha	3.58
St. Louis	1.58
Ironton and Jackson, O., to:—	
Chicago	$2.54
Cincinnati	1.26
Cleveland	1.62
Detroit	1.81
Indianapolis	1.58

SHAPES, PLATES AND BARS

Structural shapes, Pittsburgh	1.20c to 1.25c
Structural shapes, Chicago	1.39c to 1.44c
Structural shapes, Philadelphia	1.369c to 1.419c
Structural shapes, New York	1.359c to 1.409c
Struc. shapes, San Francisco	2.00c to 2.05c
Tank plates, Chicago	1.34c to 1.44c
Tank plates, Pittsburgh	1.15c to 1.25c
Tank plates, Philadelphia	1.359c to 1.409c
Tank plates, New York	1.369c to 1.419c
Bars, soft steel, Pittsburgh	1.20c to 1.25c
Bars, soft steel, Chicago	1.39c to 1.44c
Bars, soft steel, Philadelphia	1.359c to 1.409c
Bars, soft steel, New York	1.359c to 1.409c
Hoops, carloads, Pittsburgh	1.25c to 1.30c
Bands, Pittsburgh	1.20c to 1.25c
Shafting, Pbgh., contr	66 to 68 per cent off
Screw stks., Pgh. carl'ds,	68 to 70 per cent off
Bar iron, Chicago	1.20c
Bar iron, Philadelphia	1.175c to 1.225c
Bar iron, New York	1.15c to 1.20c
Bar iron, Cleveland	1.20c to 1.25c
Bar iron, Pittsburgh	1.25c
Hard steel bars, Chicago	1.20c to 1.25c
Smooth finish, mchy. steel, Chi.	1.68c

SHEETS AND TIN PLATE

No. 28, black, Pittsburgh	1.80c to 1.90c
No. 28, black, Chicago	1.89c to 1.94c
No. 28, tin mill, black, Pbgh	1.85c to 1.90c
No. 28, galvanized, Pbgh. (nom.)	5.00c to 6.00c
No. 28, galvanized, Chgo., nom	
No. 10, blue, anld., Pbgh. nom.	1.35c
No. 10, blue, annealed, Phila	1.459c to 1.509c
Tin plate, 100 lb., coke base	3.10c to 3.20c

EXTRAS FOR SHEET OR TIN MILL SPECIFICATIONS

(Per hundred pounds.)

Single pickled, cold roll, and re-anl.	30 cents
Hot roll'd pickl'd and anl., tin mill	25 cents
Full pickl'd, cold rolled and re-anl.	50 cents
Auto sheets	75 cents
Blued stove pipe stock	10 cents
Range steel	30 cents
Re-squaring	10 cents
Roller leveling	10 cents
Patent leveling and re-squaring	35 cents
Oiling sheets	10 cents
Deoxidizing	10 cents
Lime finish	10 cents
Open-hearth stamping steel, free from mill scale	55 cents
Special open hearth deep stpg. steel free from mill scale	80 cents
Extra deep special auto body stock	$1.25
Ext. for 28 gage ov. 32 to 36-in. wide	10 cents

No reduction for sheets not annealed.

The above extras apply on both sheet and tin mill specifications, at the same rate.

IRON AND STEEL PIPE

(Pittsburgh.)

	Black. Butt-weld.	Galv. Butt-weld.
Steel, ¾ to 3 inches	79	57½
Iron, ¾ to 2½ inches	71	46
	Lap-weld.	
Steel, 2½ to 6 inches	78	62½

BOILER TUBES

Steel, 3½ to 4½ inches l. c. l.	73
Iron, 3½ to 4½ inches l. c. l.	61

WIRE PRODUCTS

(Retailers' price 5 cents above jobbers' quotation.)

Wire nails jobbers, Pittsburgh	$1.55 to 1.60
Plain wire, jobbers, Pittsburgh	1.35 to 1.40
Galvanized wire, jobbers, Pbgh	2.15 to 2.20
Polished staples, Pbgh	1.55 to 1.60
Galvanized staples, Pbgh	2.35 to 2.40
Barb wire, painted, jobbers, Pbgh.	1.55 to 1.60
Barb wire, galv., jobbers, Pbgh	2.35 to 2.40

IRON AND STEEL PRICES

Corrected up to Tuesday noon

BOLTS AND NUTS

(Delivered within 20-cent freight radius.)

Carriage bolts, ⅜ x 6 inches, smaller or shorter, rolled threads, 80 and 10; cut threads 80 and 5; larger or longer, 75 and 15.

Machine bolts with hot pressed nuts ⅜ x 4 inches, smaller or shorter, rolled 80 and 15; cut, 80 and 10; larger or longer, 80.

Gimlet and cone point lag or coach screws, 85.

Hot pressed square, blank or tapped nuts. $6.40 off list; hot pressed hexagon blank or tapped, $7.30 off.

Cold pressed square, blank or tapped, $6.10 off; hexagon, blank or tapped, ⅜ inch and larger, $7.50; ⅛-inch and smaller, $8.00.

RIVETS

Structural rivets, Pbgh	1.50c
Structural rivets, Chgo	1.68c
Boiler rivets, Pbgh	1.60c
Boiler rivets, Chgo	1.78c

STEEL SHEET PILING

(Pittsburgh.)

Base sizes	1.55c to 1.60c

COLD ROLLED STRIP STEEL

(Subject to regular extras.)

0.10 to 0.19 Carbon.	Base price Cut to length	
	Hard.	Soft.
1½ inch and wider	2.85	3.10
0.100 and thicker	2.95	3.20
0.050 to 0.099 inc.	3.10	3.35
0.035 to 0.049 inc.	3.35	3.75
0.031 to 0.034 inc.	3.60	4.00
0.025 to 0.030 inc.	3.80	4.20
0.020 to 0.024 inc.	4.70	5.20
0.017 to 0.019 inc.	5.10	5.60
0.015 and 0.016	5.95	6.45
0.013 and 0.014	6.55	7.05
0.012	6.90	7.40
0.011	7.25	7.75
	Coils.	
0.100 and thicker	2.75	3.00
0.050 to 0.099 inc.	2.80	3.05
0.035 to 0.049 inc.	2.95	3.20
0.031 to 0.034 inc.	3.10	3.50
0.025 to 0.030 inc.	3.20	3.60
0.020 to 0.024 inc.	3.30	3.70
0.017 to 0.019 inc.	3.60	4.10
0.015 and 0.016	4.00	4.50
0.013 and 0.014	4.70	5.20
0.012	5.05	5.55
0.011	5.40	5.90
0.010	5.75	6.25

CAST IRON WATER PIPE

Four-inch, Chicago	26.00
Six inch and larger, Chicago	24.00
Six-inch, New York	20.50 to 21.50
Four-inch, New York	21.50 to 22.50
Four-inch, Birmingham	21.00
Six-inch and larger, Birmingham	19.00

Light weight water and gas pipe, $1 per ton higher than standard water.

WAREHOUSE PRICES

Steel bars, Chicago	1.65c
Steel bars, Cleveland	1.80c
Steel bars, Cincinnati	1.75c to 1.80c
Steel bars, Philadelphia	1.70c
Steel bars, New York	1.80c
Steel bars, St. Louis	1.70c
Iron bars, Chicago	1.65c
Iron bars, Cleveland	1.75c
Iron bars, St. Louis	1.65c
Iron bars, Cincinnati	1.70c to 1.80c
Iron bars, Philadelphia	1.55c
Iron bars, New York	1.65c to 1.70c
Hoops, Chicago	2.15c
Shapes and plates, Chicago	1.75c
Shapes and plates, Cleveland	1.90c
Shapes and plates, Cincinnati	1.85c to 1.90c
Shapes and plates, St. Louis	1.80c
Shapes and plates, Philadelphia	1.70c
Shapes and plates, New York	1.85c
No. 10 blue anl. sheets, Chgo	1.95c
No. 10 blue anl. sheets, Cleve	2.05c
No. 10 blue anl. sh. St. Louis	2.00c
No. 10 blue anl. sheets, Cinci	2.00c
No. 28 black sheets, Chgo	2.45c
No. 28 black sheets, Cleveland	2.45c
No. 28 black sheets, Cincinnati	2.45c to 2.55c
No. 28 black sheets, St. Louis	2.55c
No. 28 galv. sheets, Chicago	4.85c to 5.00c
No. 28 galv. sheets, Cleveland	5.50c to 6.00c
No. 28 galv. sheets, Cincinnati	5.50c to 6.00c
No. 28 galv. sheets, St. Paul	5.50c to 6.00c

Freight Rates, Coke

Connellsville regions, per 2,000 lbs., to:—	
Baltimore	$1.80
Buffalo	1.85
Chicago	2.50
Cleveland	1.60
Detroit	2.10
East St. Louis	2.80
Joliet	2.50
Louisville	2.50
Milwaukee	2.70
New York	2.85
Philadelphia	2.05
Pittsburgh	.75
Richmond, Va.	2.94
Toledo	1.85
Valley Furnaces	1.20
Cincinnati	2.00

IRON AND STEEL SCRAP

(Net Tons.)

No. 1 railroad wrought, Chgo	$ 8.75 to 9.25
No. 1 railroad wrought, Cleve	9.25 to 9.50
No. 1 railroad wrought, St. L	8.25 to 8.75
No. 1 railroad wrought, Cincin	7.50 to 8.00
No. 2 railroad wrought, Chgo	8.25 to 8.50
No. 2 railroad wrought, St. L	8.00 to 8.25
Arch bars and transoms, Chgo	12.00 to 12.50
Arch bars and transoms, St. L	11.50 to 12.00
Knuckles, coup. & spr'gs, Chgo	8.75 to 9.00
Knuckles, coup. & spr'gs, St. L	8.25 to 8.75
Shafting, Chicago	12.00 to 12.25
Shafting, St. Louis	11.00 to 11.50
Steel car axles, Chicago	10.00 to 10.25
Steel car axles, St. Louis	10.25 to 10.50
Locomotive tires, Chicago	8.50 to 9.00
Locomotive tires, St. Louis	8.75 to 9.25
Cut forge, Chicago	8.25 to 8.50
Pipes and flues, Chicago	6.25 to 6.75
Pipes and flues, Cleveland	7.25 to 8.00

Freight Rates, Finished Material

From Pittsburgh, carloads, per 100 lbs. to:—	
New York	16.9 cents
Philadelphia	15.9 cents
Boston	18.9 cents
Buffalo	11.6 cents
Baltimore	15.4 cents
Cleveland	10.5 cents
Cincinnati	15.8 cents
Chicago	18.9 cents
Minneapolis and St. Paul	32.9 cents
Denver	68.6 cents
St. Louis	23.6 cents
New Orleans	30 cents
Birmingham	45 cents
Pacific coast, (all rail)	80 cents
Pacific coast, via Panama canal	61.9 cents

Pipes and flues, St. Louis	6.00 to 6.50
No. 1 cast, Chicago	9.00 to 9.25
No. 1 cast, Cleveland	10.00
No. 1 cast, Cincinnati	8.50 to 9.00
No. 1 cast, St. Louis	8.75 to 9.25
No. 1 busheling, Chicago	7.25 to 7.75
No. 1 busheling, Cleveland	8.50 to 8.75
No. 1 busheling, Cincinnati	6.00 to 6.50
No. 1 busheling, St. Louis	6.75 to 7.25
No. 2 busheling, Chicago	6.00 to 6.50
No. 1 boiler plate, cut, Chgo	5.50 to 5.75
No. 1 boiler plate, cut, St. L	5.25 to 5.50
Boiler punchings, Chicago	8.25 to 8.75
Cast borings, Chicago	5.25 to 5.50
Cast borings, Cleveland	6.00 to 6.25
Cast borings, Cincinnati	4.75 to 5.25
Cast borings, St. Louis	5.25 to 5.50
Machine shop turnings, Chicago	5.00 to 5.50
Machine shop turnings, Cleve	5.75 to 6.00
Machine shop turnings, Cinci	$ 4.25 to 4.75
Machine shop turnings, St. L	5.50 to 5.75
Malleable agricultural, Chicago	7.50 to 7.75
Malleable agricultural, St. Louis	6.00 to 6.50
Malleable, railroad, Chicago	8.00 to 8.50
Malleable, railroad, Cincinnati	6.00 to 6.50
Malleable, railroad, St. Louis	6.50 to 7.00
Angle bars, iron, Chicago	11.75 to 12.25
Angle bars, iron, St. Louis	10.25 to 10.75
Angle bars, steel, Chicago	8.25 to 8.50
Angle bars, steel, St. Louis	8.25 to 8.50
Stove plate, Chicago	7.75 to 8.00
Stove plate, Cleveland	8.00 to 8.25
Stove plate, Buffalo	8.25 to 8.75
Stove plate, Cincinnati	6.00 to 6.50
Stove plate, St. Louis	6.25 to 6.50
Bundled sheet, Cincinnati	4.75 to 5.25

(Gross tons.)

Heavy melting steel, Pbgh	$11.75
Heavy melting steel, Buffalo	10.50 to 11.00
Heavy melting steel, Chicago	9.50 to 9.75
Heavy melting steel, Cleveland	10.25 to 10.75
Heavy melting steel, Cincinnati	8.50 to 9.00
Heavy melting steel, eastern Pa	11.25 to 11.50
Heavy melting steel, New York	8.50 to 9.00
Heavy melting steel, St. Louis	9.25 to 9.50
Grate bars, Buffalo	9.00 to 9.50
Grate bars, New York	6.50 to 7.00
No. 1 railroad wrought, east. Pa	12.75 to 13.00
No. 1 railroad wrought, Pbgh	10.25
No. 1 R. R. wrght., New York	10.50 to 11.00
No. 1 R. R. wrought, Buffalo	10.50 to 11.00
Shafting, New York	12.75 to 13.00
Shafting, eastern Pa	15.00 to 15.50
Wrought pipe, New York	8.25 to 8.50
Wrought pipe, eastern Pa	10.50 to 10.75
Mch. shop turnings, New York	6.00 to 6.25
Machine shop turnings, Buffalo	5.75 to 6.25
Mch. shop turnings, Pbgh	8.00
Mch. shop turnings, eastern Pa	8.25 to 8.50
Cast borings, New York	6.00 to 6.25
Cast borings, eastern Pa	8.25 to 8.50
Cast borings, Buffalo	6.50 to 6.75
Cast borings, Pittsburgh	8.50 to 8.75
Stove plate, N. J. points	9.00 to 9.25
Stove plate, Pittsburgh	8.25 to 8.75
Stove plate, eastern Pa	9.00 to 9.50
Shoveling steel, Chicago	9.00 to 9.25
Shoveling steel, St. Louis	8.00 to 8.25
Reroll. rails, 5 ft. & ov., Pbgh	12.00 to 12.50
Reroll. rails, 5 ft. & ov., Chgo	10.00 to 10.50
Reroll. rails, 5 ft. & ov., Cleve	10.50 to 11.00
Reroll. rails, 5 ft. & ov., E. Pa	11.50 to 12.00
Reroll. rails, 5 ft. & ov., St. L	10.25 to 10.75
Steel rails, short, Chicago	10.00 to 10.50
Steel rails, short, Cleveland	11.75 to 12.00
Steel rails, short, St. Louis	9.50 to 9.75
Iron rails, Cleveland nom	11.75 to 12.00
Iron rails, Chgo	12.00 to 12.50
Iron rails, Cincinnati	10.25 to 10.75
Iron rails, St. Louis	10.50 to 11.00
Iron rails, Pittsburgh (nom.)	12.50 to 13.00
Frogs, switches, guards, Chgo	9.50 to 9.75
Frogs, switches, guards, St. L	9.25 to 9.50
Car wheels, (iron), Pittsburgh	11.50
Car wheels, (steel), Pittsburgh	12.25 to 12.50
Car wheels, Chicago	10.00 to 10.25
Car wheels, eastern Pa	10.75 to 11.25
Car wheels, Buffalo	10.00 to 10.50
Car wheels, N. J. points	9.50 to 9.75
Car wheels, St. Louis	9.75 to 10.00
Iron axles, Pittsburgh	17.50
Iron axles, Cincinnati	19.00 to 20.00
Iron axles, eastern Pa	18.50 to 19.00
Iron axles, Chicago	15.25 to 15.75
Iron axles, Buffalo	16.00 to 16.50
Iron axles, St. Louis	13.75 to 14.25
Steel car axles, New York	13.50 to 14.00
Steel car axles, Buffalo	12.00 to 12.50
Steel car axles, Cleveland	12.00 to 12.50
Steel car axles, eastern Pa	14.00 to 14.50
No. 1 busheling, Buffalo	8.50 to 9.00
No. 1 busheling, Pittsburgh	9.75 to 10.00
No. 2 busheling, Buffalo	6.50 to 7.00
Low phos. steel, Buffalo	12.50 to 13.00
Low phosphorus steel, Pbgh	15.00 to 15.25
Low phos. steel, eastern Pa	15.00 to 15.25
No. 1 forge, eastern Pa	8.50 to 9.00
No. 1 cast, eastern Pa	12.00 to 12.50
No. 1 cast, Pittsburgh	11.75 to 12.00
No. 1 heavy cast N. J. points	11.50 to 11.75
Mall. railroad, Cleveland	10.25 to 10.50
Malleable railroad, Pittsburgh	10.00
Malleable railroad, Buffalo	9.50 to 10.00
Malleable railroad, east Pa	9.25 to 9.75
Bundled sheet, Pittsburgh	9.00
Bundled sheet, Cleveland (nom.)	8.50 to 9.00
Bundled sheet, Buffalo	7.00 to 7.50

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Illinois Malleable Iron Co.
Chicago, Ill.

Malleable and Gray Iron

CASTINGS

Surface Decarburization of Steel

(*Continued from page* 1306)

ments. In the case of the piece just examined, it is manifestly evident that at least 0.015 inch must be removed from the surface to entirely remove all traces of decarburization. It is obvious this piece has not been properly manipulated either in the heat treatment or the mill. This conclusion gives rise to the question as to whether the cause lies with the mill or the heat treatment, or possibly a combination of both. This can, of course, be readily determined by a micrographic examination before any heat treatment has been attempted. Results will no doubt differ considerably for different types and sections of steel finished by different processes and made for diverse purposes.

Fig. 2 shows a cross-section of a small hot-rolled section as furnished by the mill. With the exception of normalizing, it has been given no further treatment. It shows evidences of decarburization to the depth of about 0.010 inch. In Fig. 3 is shown a piece of the same steel.

All the zone decarburized by the mill was removed and the piece was then heat-treated according to the practice in vogue for its particular application. This consisted of heating to about 790 degrees Cent. for 20 minutes and then quenching in oil. In this case, however, the time in the furnace was purposely prolonged to a period of three hours to accentuate any decarburizing effects. It will be noted that the decarburized zone is not over 0.005 inch, and hence it was less than that produced by the mill.

Another piece of this same stock similarly prepared, but kept in the furnace nine hours, is shown in Fig. 4. Here it will be observed that the decarburization is about as deep as that produced by the mill. We, therefore, note that in this particular instance the mill was the most potent factor in causing decarburization, as that caused by heat treatment was not very marked, except where the duration of the time in the furnace was abnormally prolonged.

In conclusion, it may be stated that surface decarburization frequently exists in heat-treated steel parts, due either to the mill practice or to the heat treatment itself. From whatever cause, it should be investigated by the metallurgist and its extent ascertained. The microscope is undoubtedly the most efficient means of accomplishing this purpose in hypoeutectoid steels. When the exact cause and extent have been determined, means may be provided for correcting it—at least to a certain extent. In the grinding operation, however, there sometimes lies the opportunity of entirely removing its deleterious effects by a judicious determination of the grinding limits, and in this the metallurgist should play a more conspicuous part than he has in the past.

Rolling Stock in Russia

At a recent conference of representatives of Russian car works at Petrograd, it was decided that the Russian works are able to increase their output to 60,000 cars per annum. Before doing this, the car works wish assurance that the increased output will be required during several years, as otherwise they could not risk the expenses for the necessary increase in equipment. A special statement to this effect was forwarded to the ministry of ways of communications.

In regard to the construction during this year of 40,000 cars already ordered by the government and private railways, the representatives of the car works stated that they undertook to fill this order on condition that the

works received all the required material and fuel without delays. Otherwise it would be impossible to deliver the ordered cars at the given terms. At present the scarcity of fuel has forced some of the works to limit their output. One of the most important car-building works is working only two or three days per week.

Fluorspar Production Decreases

The quantity of domestic fluorspar reported to the United States geological survey as marketed in 1914 was 95,116 short tons, valued at $570,041, compared with 115,580 short tons, valued at $736,286, marketed in 1913, a decrease in quantity of 20,464 short tons and in value of $166,245, according to statistics compiled by Ernest F. Burchard. Notwithstanding this decrease, the production of 1914 has been exceeded only by that of 1912 and 1913. The average price per ton at mine or mill for the whole country, considering all grades of fluorspar—gravel, lump and ground—was approximately $5.99 in 1914, compared with $6.37 in 1913, a decrease of 38 cents a ton.

The market for the bulk of the fluorspar sold in the United States depends on the steel industry, and when that industry becomes depressed the demand for fluorspar quickly diminishes. Gravel spar is consumed as a flux in basic open-hearth steel furnaces and to a smaller extent in other metallurgic operations. In 1914 the marketed production of gravel spar constituted about 83.3 per cent of the total marketed output of domestic fluorspar.

The market for lump flourspar for the manufacture of hydrofluoric acid is reported to be improving. This report appears to be confirmed by the increase of nearly 55.8 per cent in quantity and 91.3 per cent in value of sales in 1914, in connection with which the price per ton increased about 22.8 per cent.

In Illinois the output in 1914 came from three mines, all in Hardin county. Spar was shipped from 10 mines in Kentucky (nine in Chittenden county and one in Livingston county), one mine in New Hampshire, and five mines in Colorado. The mines in Arizona and New Mexico that were active in 1913 reported that there was not sufficient demand for their product to warrant any shipments during 1914.

Baryte Industry in 1914

During 1914, the United States used 34,315 short tons of refined barytes and paid $447,358 for it, according to statistics compiled by James M. Hill, of the United States geological survey. Most of this product was used in white paint.

The barytes mines of Missouri, Alabama, California, Georgia, Kentucky, North Carolina, South Carolina and Virginia dug 51,547 tons during 1914, for which they received $153,715, or $2.98 a ton.

An item of particular interest during 1914 was the discovery that the barytes veins near El Portal, Mariposa county, Cal., turn into witherite (barium carbonate) at relatively shallow depths. Heretofore deposits of witherite of commercial size were unknown in the United States, and all the barium carbonate used, was either imported from Germany or made from barytes at considerable expense.

Another stride in the "Made in America" movement is the establishment of plants for the manufacture of barium chemicals at Charleston, W. Va., and at Melrose, Cal.

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Minimum, 50 words, $1.00. Each additional word, 2c. All capitals, 50 words, $1.50. Each additional word, 3c.

Position Wanted
Minimum, 25 words, 50c. Each additional word, 2c. All capitals, 25 words, 75c. Each additional word, 3c.

Miscellaneous Classified
Minimum, 25 words, $1.00. Each additional word, 4c. All capitals, 25 words, $2.00. Each additional word, 8c.

Remittance should be made to cover eight (8) words for address if box number is used.

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Men Wanted

HELP WANTED:—SALESMAN ON 40 per cent commission basis to handle new $6 boring tool which sells on sight. Address Box 446, THE IRON TRADE REVIEW, Cleveland, O.

WANTED:—A-1 FOREMAN FOR GRAY iron foundry in middle west doing railroad work; open shop; must be a hustler; state age, experience and references, also salary wanted. Address Box 461, THE IRON TRADE REVIEW, Cleveland, O.

UNDERSIGNED COUNSEL WILL CONFIDENTIALLY negotiate preliminaries for important executive, technical, administrative and professional positions, insuring strictest privacy. Not an agency, but a highly-endorsed, high grade method of negotiating preliminaries only, for $3,000 to $12,000 men. Send address only for explanation. R. W. Bixby, F1 Niagara Square, Buffalo, N. Y.

THE BEST WAY TO GET A GOOD POsition in drafting or engineering is to file an application direct with some of our clients who are depending on us to get competent and experienced applicants for their vacant positions. Send stamp for blank and list of vacant positions. The Cleveland Engineering Agency Co., Rose building, Cleveland, O.

Positions Wanted

WANTED: — POSITION AS FOUNDRY superintendent or foreman; 22 years as foundry foreman in gray iron, brass, semi-steel and cupola; up to date on machinery molding and general foundry work; sober and dependable with A-1 references. Address Box 455, THE IRON TRADE REVIEW, Cleveland, O.

OPERATING SUPERINTENDENT AND efficiency executive of crucible, electric and open hearth steel plants and rolling mills, fully qualified by seventeen years successful plant management experience, desires position wherein practical metallurgical, producing, economic, statistical and financial experience are required. Address Box 409, THE IRON TRADE REVIEW, Cleveland, O.

MECHANICAL ENGINEER; TECHNIcal training; 18 years' experience gas engines, machine tools, mill buildings, hydraulic machinery, ordnance work; 14 years in charge of work; 6 years as superintendent; can fill position of superintendent or chief engineer; good references. Address Box 341, THE IRON TRADE REVIEW, Cleveland, O.

BLAST FURNACE SUPERINTENDENT who can produce results wishes position. Preferably with company manufacturing Bessemer or Basic for own steel plant. References furnished. Address Box 441, THE IRON TRADE REVIEW, Cleveland, O.

POSITION WANTED — BY MECHANical engineer having 20 years experience as a machinist, tool-die maker, general metal manufacturing line, also drafting, thoroughly understands systematizing so as to get the highest efficiency at the minimum cost. Age 35. At present holding executive position. Address Box 450, THE IRON TRADE REVIEW, Cleveland, O.

Positions Wanted

FOUNDRY FOREMAN, HAVING BEEN in business and knowing the foundry business from the bottom up is looking for a position; up-to-date on cupolas, molding machines and economical production. Address Box 432, THE IRON TRADE REVIEW, Cleveland, O.

STEEL FOUNDRY FOREMAN, 15 years' experience in open hearth, converter and manganese steel castings, both green and dry sand. Address Box 333, THE IRON TRADE REVIEW, Cleveland, O.

EXPERIENCED PATTERN MAKER wishes position as foreman; over 10 years in charge of shops employing from 20 to 100 men making patterns for gas and oil engines and electrical machinery. Broad experience with molding machines. Address Box 253, THE IRON TRADE REVIEW, Cleveland, O.

STEEL FOUNDRY SUPERINTENDENT or general foreman; young man of unquestioned ability and character would like to connect with a firm offering a future. Address Box 434, THE IRON TRADE REVIEW, Cleveland, O.

STEEL FOUNDRY SUPERINTENDENCY by aggressive, competent man; crucible, electric or open hearth plants preferred. Expert knowledge of mixtures, melting, molding, casting and cost. Savings effected; refinements introduced. Address Box 410, THE IRON TRADE REVIEW, Cleveland, O.

POSITION WANTED—BY MECHANICal engineer having 22 years experience as a mechanic in the steel line, thoroughly understand the heat treatment of Alloy, Carbon and High Speed Steels. At present employed as mechanical engineer, desires position in the Steel or Machinery line. Address Box 451, THE IRON TRADE REVIEW, Cleveland, O.

GRADUATED MECHANICAL ENGINEER, 32 years, with 3 years shop experience and 8 years as designer in car work, rolling mill and steel plant work, desires position as assistant master mechanic or assistant mechanical engineer, in taking care of repair work, or smaller engineering office. At present employed in Pittsburgh district. Best of ability and character references furnished. Address Box 438, THE IRON TRADE REVIEW, Cleveland, O.

EXECUTIVE

15 years manufacturing experience; 4 years under F. W. Taylor at Bethlehem Steel. Experienced in all departments, shop, design, office and management. Not merely a system man but a practical experienced organizer, sure of results if proposition is undertaken. Have organized several plants that were not making proper returns and have demonstrated results that were unusual. Have turned bad losses into profits the first year. Can get and fill contracts for war material if machinery is suitable. Will only consider proposition of some size that is financially sound. Have clean past record. Technical graduate. Address Box 447, THE IRON TRADE REVIEW, Cleveland, O.

Positions Wanted

WHEN YOU NEED A HIGH GRADE executive, engineer, draftsman or any technical man, consult The Engineering Agency, Inc., (Est. 21 years) 1662 Monadnock Block, Chicago.

IRON METALLURGIST, CHEMIST, metallographist, 8 years iron and steel experience, desires foundry position in charge of cupolas, efficiency and safety work. Successful executive with initiative ability; now handling 40 men on a scientific management basis. Married; age 36. Location middle west or south. Address Box 457, THE IRON TRADE REVIEW, Cleveland, O.

POSITION WANTED AS FOUNDRY superintendent or foreman; stove preferred. Can handle men efficiently. Have also had experience on match plate and molding machine. Looking for something permanent. Address Box 372, THE IRON TRADE REVIEW, Cleveland, O.

PATTERN MAKER FOREMAN; SIX years experience; wishes to make change. Experience in pump and engine works, etc. Address Box 453, THE IRON TRADE REVIEW, Cleveland, O.

A PATTERN MAKER OF 18 YEARS' experience, the last 11 of which as foreman, desires an executive position in one of the southern states. Satisfactory reference regarding mechanical ability, character and health cheerfully furnished. Address Box 454, THE IRON TRADE REVIEW, Cleveland, O.

PLATE OR STRUCTURAL STEEL draftsman, estimator, layerout, templetmaker or fitter. Good mathematician, seven years experience. Industrious, reliable. Address Box 464, THE IRON TRADE REVIEW, Cleveland, O.

A POSITION AS CHIEF MILLWRIGHT or master mechanic wanted by a young man 31 years old, technically educated, 6 years experience handling repairs on rolling mills and open hearth furnaces, good references. Address Box 466, THE IRON TRADE REVIEW, Cleveland, O.

FOUNDRY SUPERINTENDENT, PRACtical, with experience in some of the best plants in the country, heavy and light work, strictly temperature. Expert on cupola practice. Address Box 467, THE IRON TRADE REVIEW, Cleveland, O.

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Alphabetical list of Advertisers, page 113.
Opportunities, page 108.
Table of Contents, page 31.
Second-Hand Machinery, page 110.
"Where-to-Buy," page 116.
Engineering Directory, page 138.

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Fig. 70.
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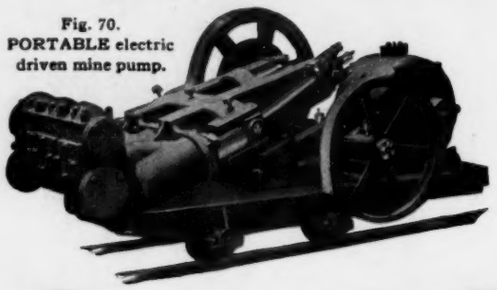

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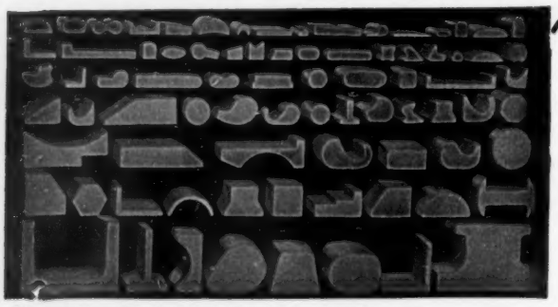

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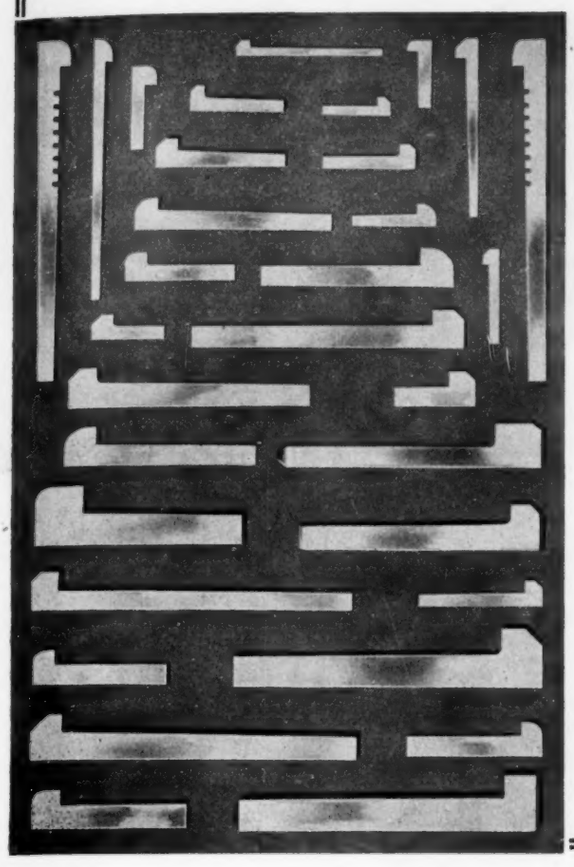

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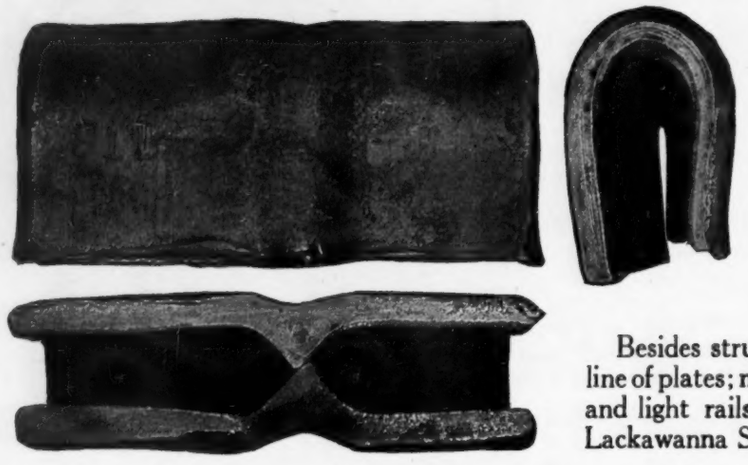

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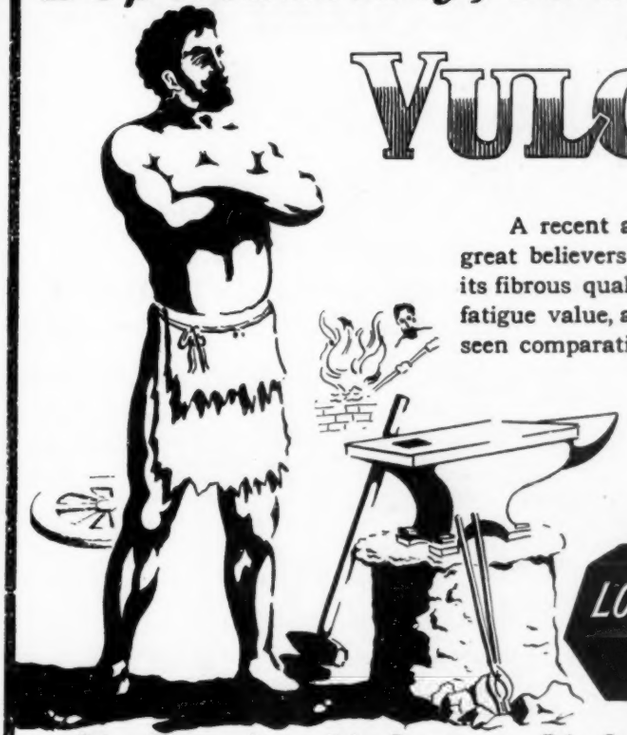

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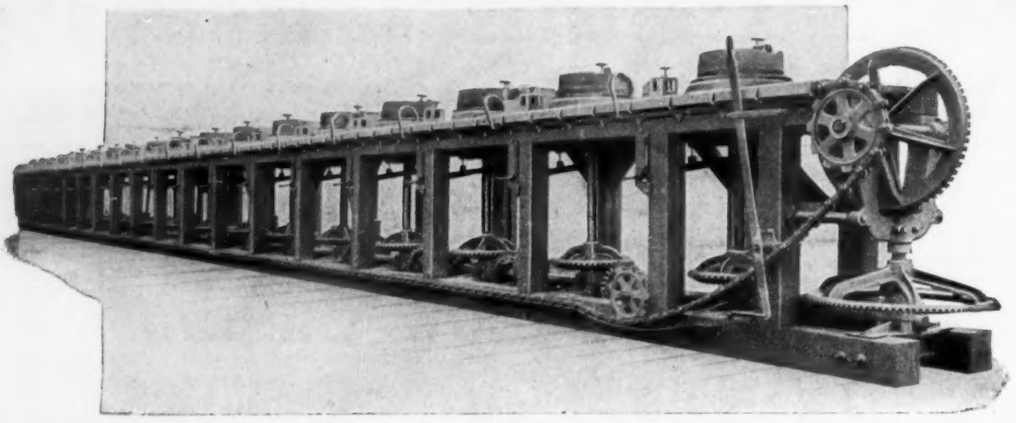

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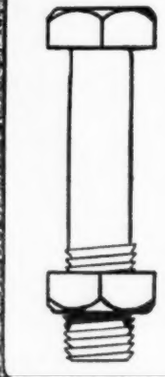

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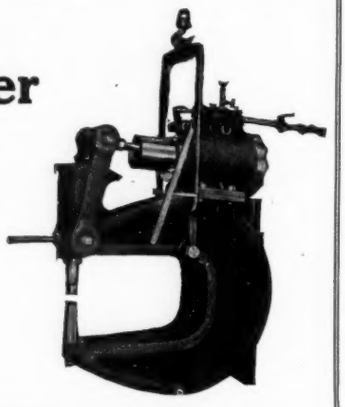

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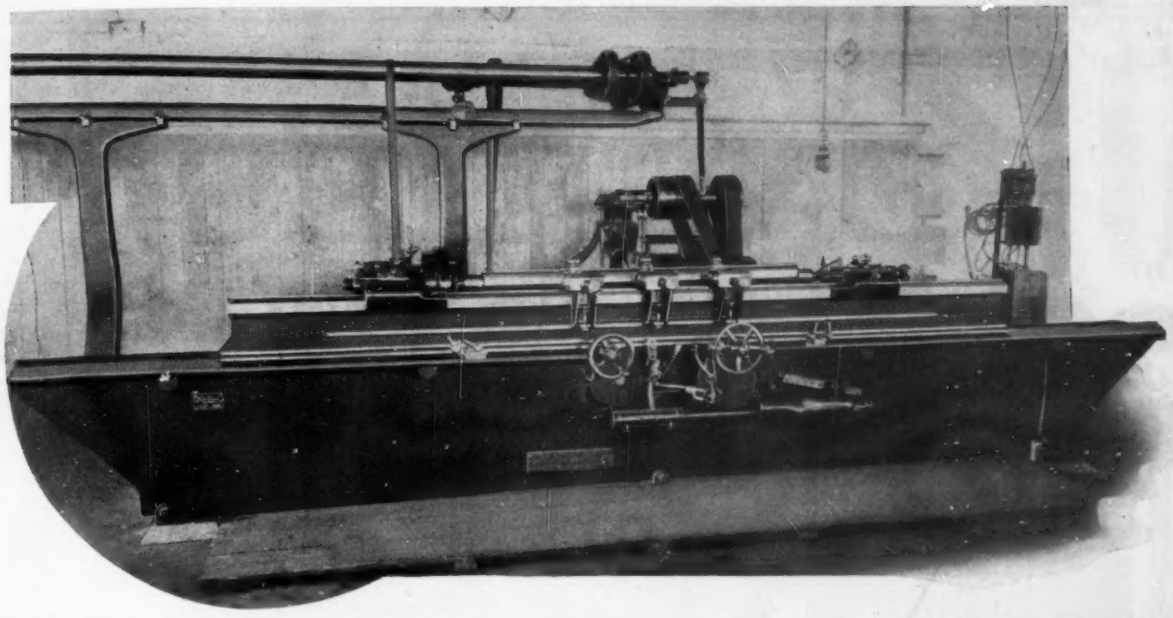


For Extreme Accuracy, Too!

Let us know just what the conditions are in ***your*** *plant. Perhaps we can make* ***you*** *a proposition worth while.*

The above illustration shows a Norton Grinding Machine in use at the plant of the Phillips Sheet & Tin Plate Company, Weirton, W. Va.

This machine is used for the grinding of tinning rolls that vary in length from three to eight feet, and in diameter from three and one-half to six inches.

These tinning rolls are used in sets of four, and when removed for grinding it is often found that while some of them may have become worn as much as one-sixteenth of an inch, the wear on others is almost unnoticeable.

These rolls must all be made the size of the *smallest*—EXACTLY. Therefore EXTREME ACCURACY must be a feature of the machine that grinds them.

It is a fact worth remembering, that the Norton Grinding Machine is unfailing in its control. No matter how *heavy*, no matter how *light* a cut you wish to make, the "Norton" is always ready for the job, and EXTREME ACCURACY IS THE RESULT EVERYTIME!

Write us for full information concerning the remarkable work that is being performed by NORTON GRINDING MACHINES—you'll feel well repaid.

NORTON GRINDING CO., Worcester, Mass.

Chicago Store, 11 North Jefferson Street

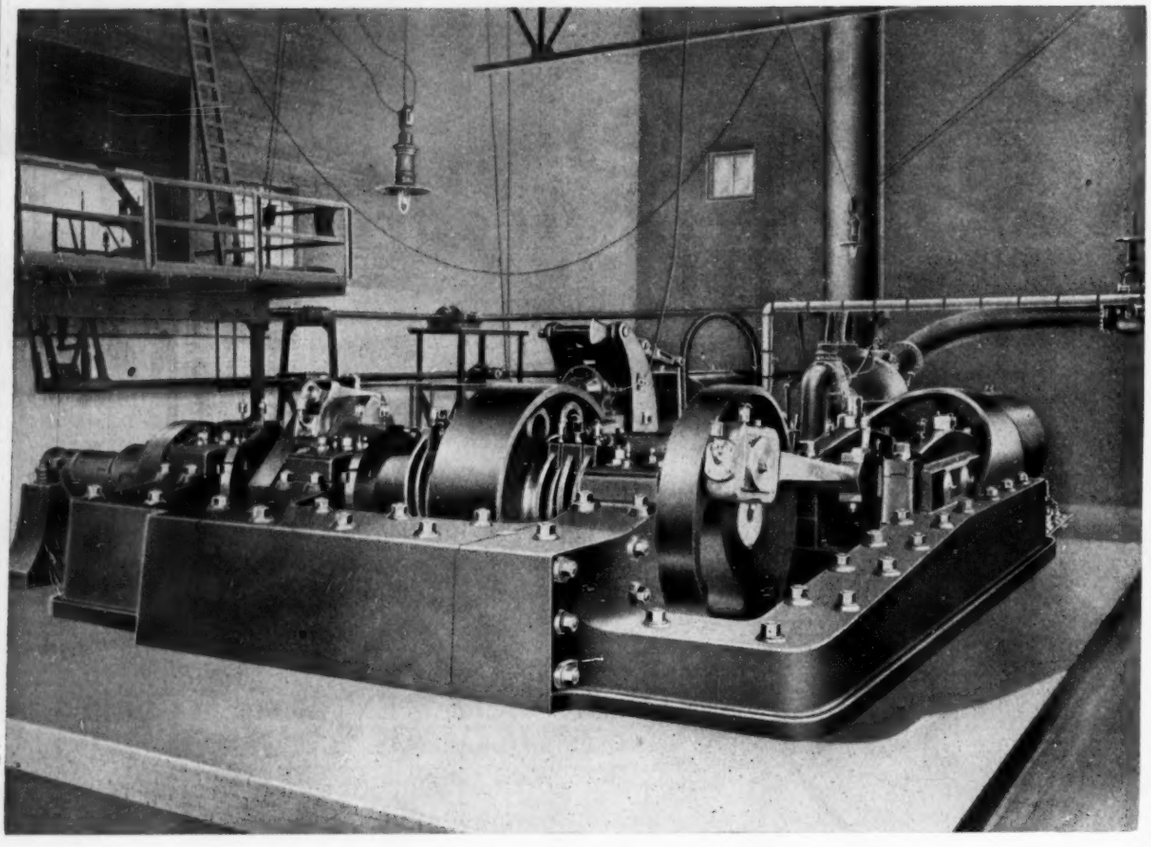
AGENTS: Vonnegut Machinery Co., Indianapolis. Robinson, Cary & Sands Co., St. Paul and Duluth. Manning, Maxwell & Moore, Inc., St. Louis. The Motch & Merryweather Machinery Co., Cleveland, Pittsburgh, Cincinnati and Detroit. Eccles & Smith Company, San Francisco, Portland, Ore. and Los Angeles. Prentiss Tool & Supply Co., New York, Boston, Rochester, Buffalo, Syracuse and Scranton. W. E. Shipley Machinery Co., Philadelphia. Kemp Machinery Co., Baltimore. C. T. Patterson Co., New Orleans. Canadian Fairbanks-Morse Co., Montreal, Toronto, Winnipeg and Vancouver. Alfred Herbert, Ltd., Coventry, England, Paris and Milan. Schuchardt & Schutte, Vienna, Prague, Budapest, St. Petersburg and Stockholm. The F. W. Horne Co., Tokio, Japan. 354-N

ENGINES

of every description

for

Rolling Mill Purposes



[48" and 72" x 60" Cross-Compound Direct-Connected Reversing Engine for driving the Three-High Structural Mill. Installed at the Works of the Eastern Steel Company, Pottsville, Pa.

MACKINTOSH, HEMPHILL & CO.
FORT PITT FOUNDRY
PITTSBURGH, PA.

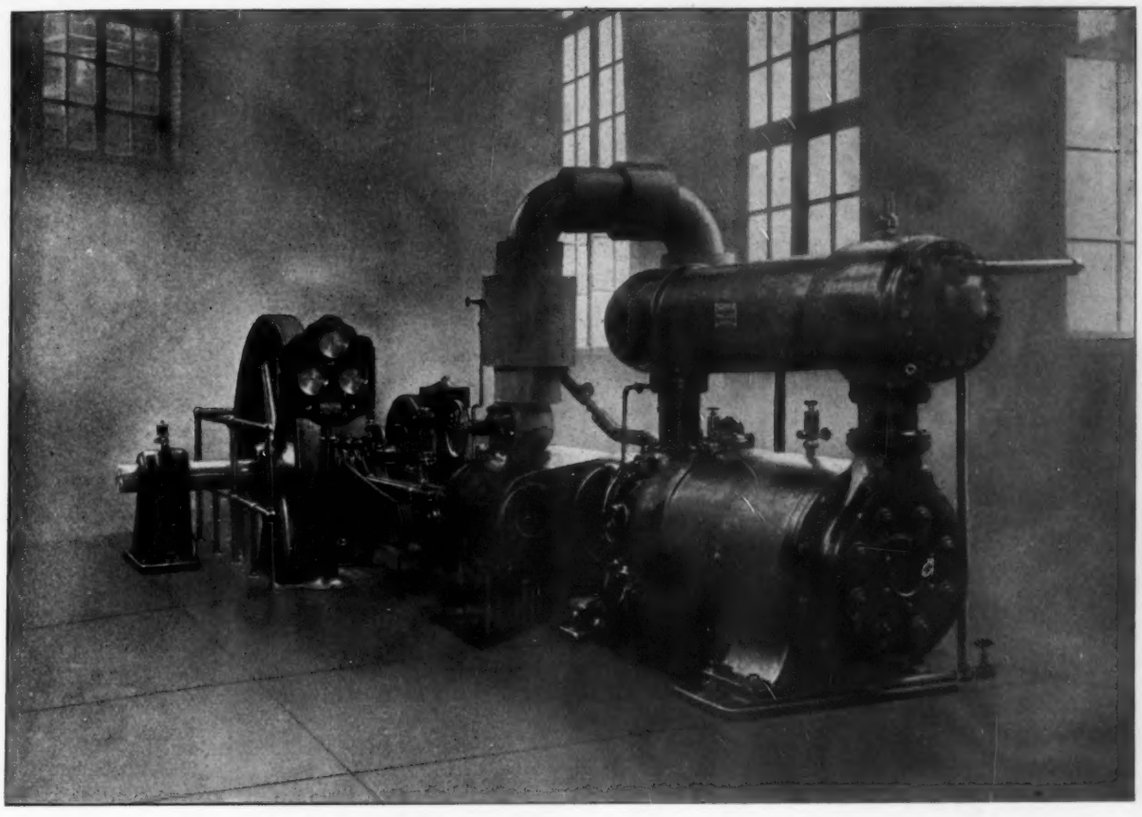
AIR and GAS COMPRESSORS

EQUIPPED WITH

MESTA AUTOMATIC PLATE VALVES

(IVERSEN PATENT)

NO VALVE GEAR NO ADJUSTMENTS



Mesta Automatic Plate Valves (Iversen Patent) make possible much higher piston speeds than were heretofore used. They do it with increased economy and reliability. The volute shape of the spring and the relative proportions of the valve plate, seat, and guard make possible, also, remarkably low speeds without fluttering of the valve.

The Mesta Machine Company is equipping existing compressors of various makes with Automatic Plate Valves or with new air heads containing them.

WRITE FOR BULLETIN "N"

It contains useful data on air compressor efficiency.

MESTA MACHINE COMPANY

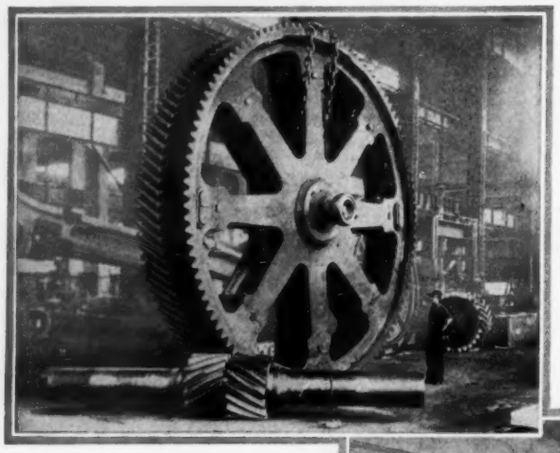
PITTSBURGH, PA., U. S. A.

WORKS: MESTA STATION, P. R. R., WEST HOMESTEAD, PA.

DESIGNERS AND BUILDERS OF

GAS AND STEAM ENGINES, ROLLING MILL MACHINERY, FORGING PRESSES, CONDENSERS, ETC.

CUT GEARS



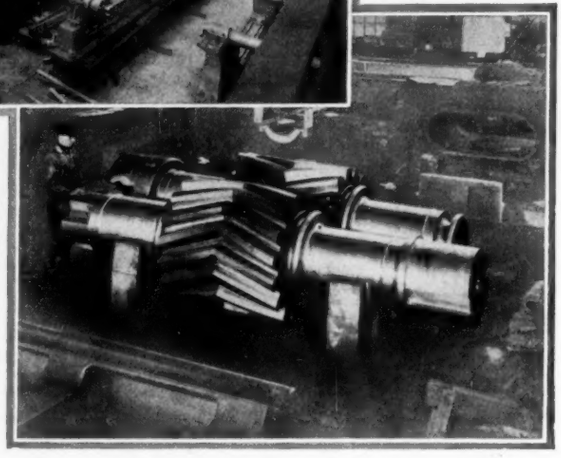
We can completely machine spur or double helical gears as large as it is possible to ship.

Sheet Mill Drive, Gear 232" PD. 42" face, weight 70 tons, pinion 30" PD, weight, 15 tons.

Continuous Mill Drive

We are prepared to design, cast, machine, assemble and test the entire drive.

44" Nickel Steel Mill Pinions, weight each 44,000 pounds.

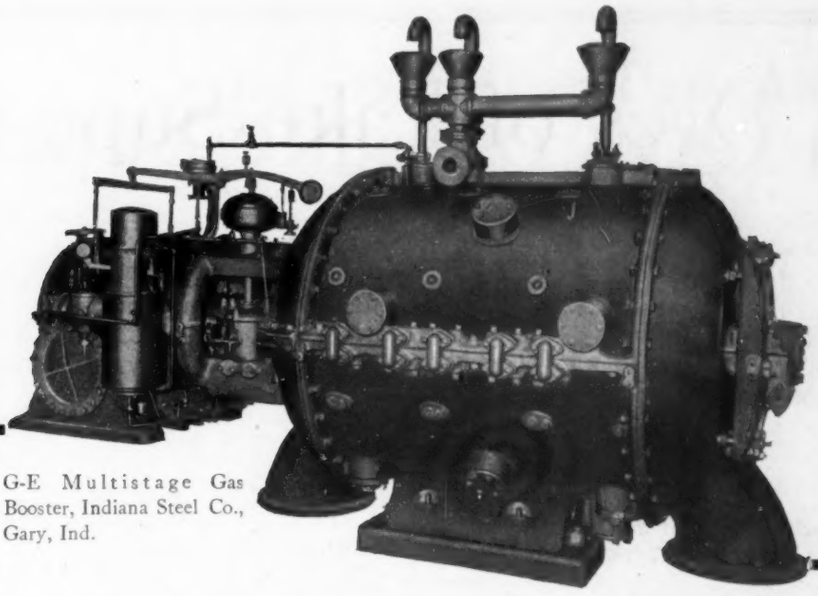


Compared with cast gears, cut gears save 10% of the power transmitted and 75% of the cost of the upkeep of bearings.

The William Tod Company

YOUNGSTOWN, OHIO

ENGINES—Mill, Reversing, Blowing, Gas, Pumping
Rolling Mills Special Machinery Hydraulic Forging Presses
Iron and Brass Castings



G-E Multistage Gas Booster, Indiana Steel Co., Gary, Ind.

Centrifugal Gas Boosters and Exhausters

G-E Centrifugal Gas Compressors may be used as gas boosters between holder and point of consumption.

When equipped with constant suction governors these compressors can be used as exhausters to handle the gas from the ovens and force it through the purifying system.

Their great simplicity of operation, the small floor space occupied, and the negligible maintenance experienced by users strongly recommend these machines to your careful consideration.

Among the users of G-E Centrifugal Gas Exhausters or Boosters in By-Product Coke Oven Plants may be mentioned the following:

Indiana Steel Co., Gary, Ind.
Tennessee Coal & Iron Co., Birmingham, Ala.
Woodward Iron Co., Woodward, Ala.
Republic Iron & Steel Co., Youngstown, Ohio
Inland Steel Co., Indiana Harbor, Ind.
Semet-Solvay, Holt, Ala.
Bethlehem Steel Co., So. Bethlehem, Pa.

We are prepared to furnish these machines in capacities of from 60,000 cubic feet per hour upwards.

Bulletin No. 48600 describing these machines in detail will be sent to you on request.

General Electric Company

Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
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Chattanooga, Tenn.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
Dayton, Ohio
Denver, Colo.
Des Moines, Iowa
Detroit, Mich.
(Office of Agent)
Duluth, Minn.
Elmira, N. Y.
Erie, Pa.
Fort Wayne, Ind.
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General Offices: Schenectady, N.Y.

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Richmond, Va.
Rochester, N. Y.
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San Francisco, Cal.
Schenectady, N. Y.
Seattle, Wash.
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Springfield, Mass.
Syracuse, N. Y
Toledo, Ohio
Washington, D. C.
Youngstown, Ohio

For Texas, Oklahoma and Arizona business refer to Southwest General Electric Company (formerly Hobson Electric Co.), Dallas, El Paso, Houston and Oklahoma City. For Canadian business refer to Canadian General Electric Company, Ltd., Toronto, Ont.

5513

Iron Ores of Lake Superior

By
CROWELL *and* MURRAY

This book has been completely revised and is up-to-the-minute in every respect. Of the greatest value to those engaged in the mining and shipping of Iron Ores.
As a mailing list it is invaluable, as it gives the names of *managers*, *superintendents* and *sales agents* of all the mines and their *location*.

CONTENTS:

CHAPTER I
The Early History of the Region
A brief history of the Lake Superior Ore region.

CHAPTER II
Geology
A concise description of the general geology of the region—Detailed geology with ideal sections of the Vermilion Range, Mesabi Range, Cuyuna Range, Marquette Range, Menominee Range, Iron River, Crystal Falls and Florence districts, Baraboo District, Michipicoten Range and Moose Mountain District.

CHAPTER III
Mineralogy
Description and composition of the various iron ores found in the Lake Superior Region.

CHAPTER IV
Production of Ore
Methods used in exploring for ore—Mining methods used on the various ranges—Transportation of the ore from the mines to shipping docks, and from docks to the Lower Lakes—Tables showing freight rates from mines to docks, and from the docks to the Lower Lakes from the opening of the various ranges to date—Tables showing tonnage shipped from each range from the opening up of the same, to date.

CHAPTER V
Dock Equipment
Details of the various loading docks at the Upper Lake Ports—Description of the Lower Lake Port unloading docks, giving the various kinds of machines used, their size, capacity and other information.

CHAPTER VI
Classification of Ores
Showing the various changes and reasons for the same, in the classification of ores from the early days of mining to date. Describing the sampling of ore at the Mines, Lower Lakes and Furnaces.—Discussion on the value of ores with tables giving the prices of ore from the opening of the ranges to date—Showing how the value of ores are figured from their analyses.

CHAPTER VII
Beneficiation of Ores
Details of the various methods of concentration used in the Lake Superior region—A description of the Coleraine Washer—The Wisconsin Steel Co.'s plant at O'Brien Lake—The Wetherbee Concentrator at the Madrid Mine—The Concentrating Plant at the American Mine—Description of the Drying Plant at the Brunt Mine—Concentrating Plant at the Moose Mountain Mine—Description of the various processes for treating fine ore and flue dust.

CHAPTER VIII
Methods of Analyses
Description of the preparation of Standard Samples after receipt in the Laboratory—Moisture determination—Details for the determination of Iron, Phosphorus, Silica, Manganese, Alumina, Lime, Magnesia, Sulphur, and Loss on Ignition in iron ores.

CHAPTER IX
Fuel Engineering
Definition of Fuel Engineering—Various fields in which it is used—The economy gained by its intelligent use.

CHAPTER X
Location and Description of Mines
Data for each mine on the various ranges, showing the location, operating company, names of manager, superintendent and sales agent, methods of working the mine, greatest depth, route for shipping the ores, yearly shipments from the opening of the mine to date, and the 1913 cargo analyses of the ores shipped by each mine—Complete geological map of each Range showing the iron-bearing formations and the location of every mine.

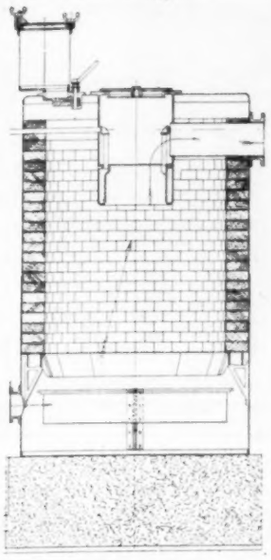
INDEX
A complete index showing the name of each mine and ore referred to, and the range to which they belong.

256 pages, featuring new maps, substantially bound in cloth.

Price $3.50 PREPAID TO ANY ADDRESS

Penton's Book News
Cleveland, Ohio

18



Section of Type "BF" Producer

Large Grate Area allows low driving rate and uniform blast distribution.

Deep Fuel Bed insures immediate response to sudden fluctuations in load. When in operation producer is filled with fuel from grate to head.

Large Fuel Magazine makes frequent charging unnecessary and insures uniform fuel distribution.

Central Gas Outlet insures even blast distribution.

Nine-Inch Brick Lining specially burned of special mixture for Smith Producers.

Hot Gas Producers Throw Away Heat

Heat Absorbing reactions in gas producers should not be allowed to predominate beyond the amount necessary to keep the producer running satisfactorily. Unnecessarily hot gas at producer outlet means low efficiency.

Smith Producers Have the Lowest Outlet Temperatures

Tests Show Only 768 to 875 Degrees Fahrenheit

Just one more reason why Smith Producers are most efficient for steel plant service, for operating bloom reheating, forging, tempering, heat treating or case hardening furnaces.

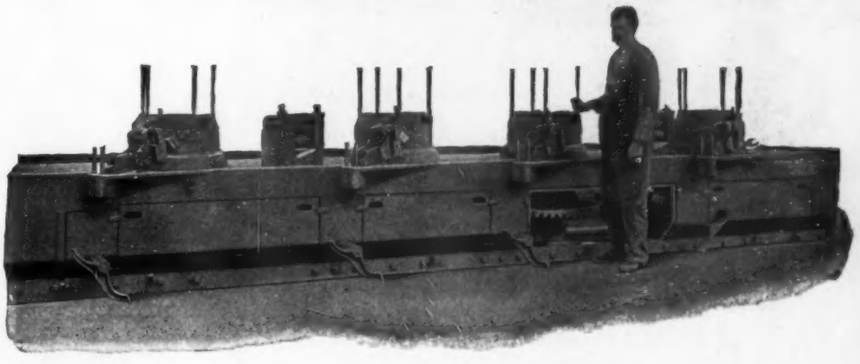
Let Us Show You How to Save Money and Fuel

The Smith Gas Power Company

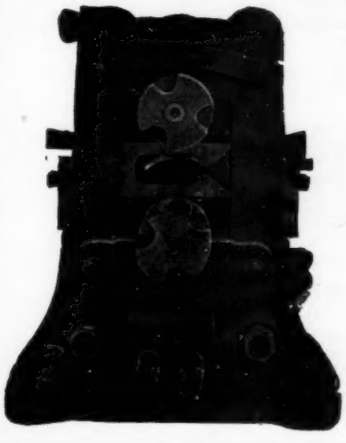
Lexington, Ohio

Sole Canadian Representatives—The Canadian Allis Chalmers, Ltd., Toronto, Can.

A line of big Money Savers



Rod Frame equipped with Carroll Friction Blocks



MILL EQUIPMENT

The above illustration shows one of our heavy rod frames equipped with ***Friction Blocks.*** Enclosed within each block is a coil clutch. We equip each block with an automatic safety stop.

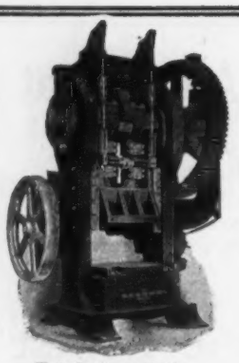
No draw-out mechanism is required, and the machine is characterized by high efficiency and low maintenance costs.

We also design and build MILLS for ***Billets, Bars, Thin Flats*** and ***Rods.*** Also Heating Furnaces; Cooling Beds; Dyblie Gas and Air Reversing Valves.

Write us for full details

Morgan Construction Co.

WORCESTER, MASS.



Toledo No. 96½ A.
Weight 75,000 lbs.
For cutting, drawing and forming pipe flange or collars, packing rings, etc.

In Every Standard by which a press is judged "TOLEDO" is supreme.

"Toledo" Double Cranks are heavy and strong with crank shafts of large diameter hammer forged of special analysis steel, high in carbon, and heat treated.

Gears and all working parts protected to give the greatest factor of safety.

The connection, clutch, construction of slide—all present exclusive features of vital importance. 150 sizes up to 500,000 lbs. weight for every variety of sheet metal and drop forging work.

The Toledo Machine & Tool Co., Toledo, Ohio

Riveting Costs Reduced by "Toledo" Welders

No. 154 Welder, 36 inch throat

The large daily output of many manufacturers of automobiles and auto parts, has been made possible by the use of the "TOLEDO" electric welder shown herewith. With the increased output of their products, *costs have been reduced from 60 to 95 per cent.*

We will prove this by shipping you a "TOLEDO" on 30 days' trial.

Write for our new Bulletins Nos. 14 and 15. They tell all about "TOLEDO" Butt Welders and Spot Welders.

No Lease—No License—No Royalty

The Toledo Electric Welder Company

2729 Knowlton St., CINCINNATI, OHIO

ARE YOU ECONOMICAL?

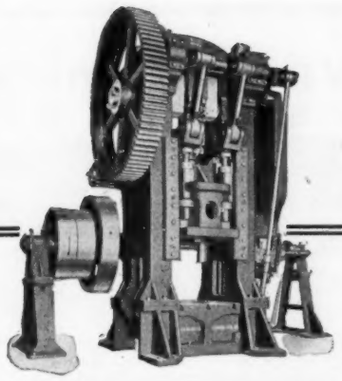
Shear Blade

Do You Know What Your Shear Blades Are Costing You?

It might surprise you—Better look into it.

We can save you 10 to 50 per cent during the year. Yes, we can. We can prove it.

The L. & I. J. White Company, 15 Columbia St., Buffalo, N.Y.



The Uniform Pressure Makes Every Shell a Good Shell

The action of the Bliss patent toggle motion facilitates the work and requires less power. Blank-holding is taken by the frame, relieving bearings.

Bliss Toggle Drawing Presses

The blank-holder starts on its upward movement nearly simultaneously with the punch, giving operator ample time for removal of drawn piece.

Bliss Toggle Drawing Presses are built in many sizes and cover every requirement. Let us send you descriptive matter covering your exact requirements. Write today.

E. W. Bliss Co., No. 8 Adams Street Brooklyn, N.Y., U.S.A.

Chicago Office—622 West Washington Boulevard
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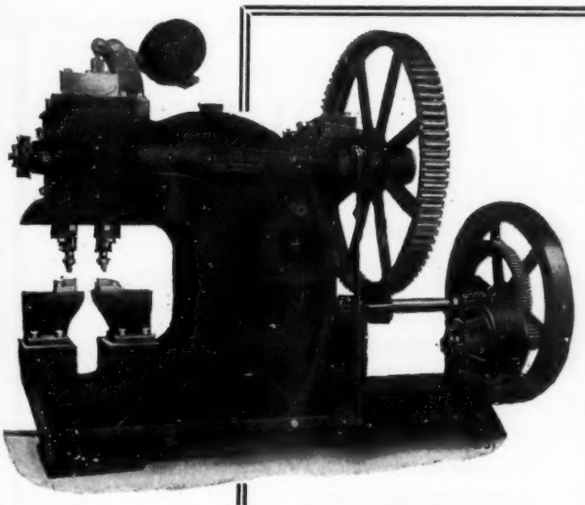
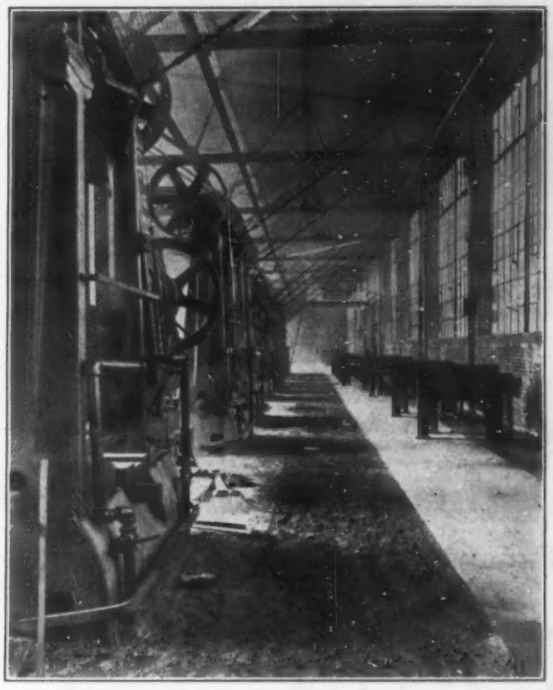


The Cleveland Punch & Shear Works Co.

Cleveland, O.

"CLEVELAND" Punches are known everywhere for their efficiency, accurateness and durability. Made of the best materials, by experienced, high grade workmen, we guarantee them to fulfill every requirement for such equipment. Send for catalog illustrating and describing in detail the "Cleveland" line of punches.



"PITTSBURGH" BOARD DROP HAMMERS

EXTRA LONG AND WIDE ROLLS
EXTRA HEAVY GUIDES
STRAIGHT FRONT ROD
STEEL LIFTER FRAME
CUT STEEL GEARS
LONG DROP

FROM 1000 TO 5000 LBS. FALLING WEIGHT.

USED BY THE U. S. GOVERNMENT AND MANY OF THE LARGEST DROP HAMMER SHOPS IN THE UNITED STATES.

WRITE FOR BULLETIN D

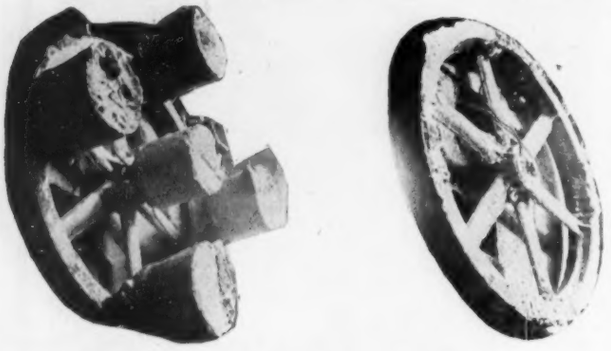
NEXT WEEK "BLOOMING MILLS"

UNITED ENGINEERING AND FOUNDRY CO.

PITTSBURGH, PA., U. S. A.

BUILDERS OF COMPLETE MACHINERY EQUIPMENT FOR IRON, STEEL AND TUBE WORKS; STEEL CASTINGS; MACHINE MOLDED GEARS; FORGING PRESSES, STEEL, SAND, CHILLED AND "ADAMITE" ROLLS.

"LARGEST ROLL MAKERS IN THE WORLD, MAKERS OF THE LARGEST ROLLS"



Before and After—
A Story of 25 Minutes

Twenty-five minutes after the operator started the last riser fell off and the job was finished.

Oxweld Apparatus

makes the cutting of risers, sprues and gates a matter of minutes instead of hours. On this particular job the total cost including time, material and labor was only $1.22. Cutting them up-to-date methods would take from 5 to 6 hours with a corresponding increase in total cost.

Let us show you what the OXWELD PROCESS can do for you. Write for details.

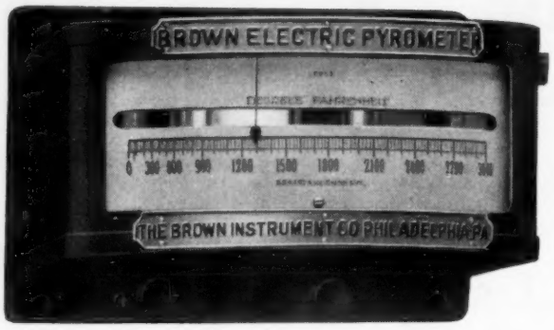
See our exhibit at the San Francisco Exposition—
Palace of Manufacturers, Collective Gas Exhibit

Oxweld Acetylene Co.

NEWARK, N. J. CHICAGO LOS ANGELES

Largest Makers of Welding and Cutting Apparatus and Supplies in the United States

Brown Pyrometers



Ask any user of Brown Pyrometers whether it is possible for any concern to take more interest in their customers than we do. Buy a Brown Pyrometer and you get Brown service also.

Ask for 64-page catalogue No. 11

The Brown Instrument Co.

Philadelphia, Pa.

New York Pittsburgh Chicago

PUBLISHED APRIL, 1914

STEEL FOUNDRY

By JOHN HOWE HALL

Consulting Engineer

271 pages, 6 x 9. Illustrated. $3.00, postpaid

THE author covers fully the *metallurgy and production of all classes of ordinary steel castings* in use in this country.

He aims to give:

(1) The characteristics of steel castings from a manufacturing point of view.

(2) The details of the various steel manufacturing processes and their characteristics as applied to the different types of castings, including relative cost of installation, relative cost and quality of steel produced, etc.

(3) Foundry procedure, such as moulding, pouring, annealing, etc.

The book will appeal alike to the metallurgist and the superintendent in charge of the foundry. It covers metallurgical processes, shop methods and costs of steel.

PENTON'S BOOK NEWS

PENTON BUILDING, ∴ CLEVELAND, OHIO

36

LINDE OXYGEN

From Coast to Coast 35 Producing Plants and Distributing Stations provide an unlimited supply of Linde Oxygen for users everywhere.

LINDE SERVICE means no investment except for oxygen actually received—no expensive overhead or upkeep charges.

Linde Oxygen may be obtained from any of the following Linde Plants and Distributing Stations where a large supply of charged 100 and 200 cu. ft. cylinders is kept on hand constantly to insure immediate shipments.

Mail or telephone your order to THE LINDE AIR PRODUCTS CO., at the nearest point. **Shipments will be made on day order is received.**

Atlanta, Ga.	
Baltimore, Md.	19 E. Lombard Street
Birmingham, Ala.	10th Ave. and 16th St., North
Buffalo, N. Y.	155 to 183 Chandler Street
Chattanooga, Tenn.	212-238 King Street
Chicago, Ill.	1501 South Peoria Street
	113 Austin Avenue
Cincinnati, Ohio	63 Plum Street
Cleveland, Ohio	E. 73rd St. and Bittern Ave.
Columbus, Ohio	310 Dublin Ave.
Davenport, Iowa	118 Harrison Street
Dayton, Ohio	Bainbridge, Bacon and State Streets
Denver, Colo.	16th and Glenarm Streets
Detroit, Mich.	St. Aubins Avenue
Duluth, Minn.	7th Ave. W. and Railroad St.
East Chicago, Ind.	
East St. Louis, Ill.	6th and Walnut Ayenue.
Elizabeth, N. J.	
Emeryville, Oakland, Cal.	
Fort Wayne, Ind.	414 East Columbia Street
Indianapolis, Ind.	108 South Alabama Street
Los Angeles, Cal.	514-18 Molina Street
Minneapolis, Minn.	500 North First Street
Newark, N. J.	15-19 Division Street (Local Deliveries only)
New York City	217 West 29th Street
Norristown, Pa.	
North Kansas City, Mo.	
Omaha, Neb.	1007-9-11 Jones Street
Pittsburgh, Pa.	25th Street and Allegheny R. R.
Portland, Oregon	104 North Fifth Street
San Francisco, Cal.	303-304 Sheldon Building
	461 Market Street
Seattle, Wash.	530 First Ave., South
St. Louis, Mo.	502 South Seventh Street
Trafford, Pa.	
Worcester, Mass.	961 Southbridge Street

Other Plants and Distributing Stations are planned for other industrial centers throughout the country and will be established as fast as and wherever the local demand for oxygen warrants.

The Linde Air Products Co.
Forty-Second St. Building New York
Largest Producers of Pure Oxygen in America

The files which do the best, "longest", are the ones for you to use on your work.

You will always find that

NICHOLSON FILES
Give the Best Service

NICHOLSON
U.S.A.
(TRADE MARK)

"NICHOLSON" stamped on a file, absolutely guarantees selected steel—forged, annealed, ground and cut by expert workmen who have made your needs a lifetime study.

SPECIFY "NICHOLSON"
AT ALL LEADING DEALERS

Our new Catalog shows 600 illustrations, and is invaluable to file users. Sent FREE on request.

Nicholson File Co.
Providence, R. I.

A Specific for Business Depression

If Hugh Chalmers' faith in advertising could be wafted throughout the field of industry, prosperity would be at the door of every manufacturer. Industry wouldn't be stinted by pessimistic demands. Hugh Chalmers has invested hundreds of thousands of dollars in advertising and has drawn a manifold reward in return. Chalmers is just one of them. There are scores in his class, all reaping their harvests.

In a recent address before a group of business men, he said:

"The two chief elements in successful business are advertising and salesmanship. Oral salesmanship is like individual teaching, while newspaper advertising, which is another form of salesmanship, is like a public school. You reach one person by one method, thousands or even millions, by the other method."

"There are only two excuses why a man should not advertise. One is because he has too much business, and don't have to, and the other is because he has too little business and can't afford to."

"Successful advertising is summed up in having the right idea, and using it at the right time."

"Advertising should be honest, sensible, and persistent."

"Advertising must be persistent because the hardest thing to find is yesterday's newspaper. If you don't believe it, try it."

*"There may be some men who believe that because they have been in business in **** all their lives that they do not need to advertise. They are like the fellow wearing blue goggles who winked at a girl. He knew he was winking, but she didn't. Just so, if a man does not advertise he may know he is in business, but the public is likely to be unaware of it."*

The above applies to the Iron, Steel, Foundry, Machinery and all other lines of business. Advertising is a necessary part of every successful sales organization. It is a business-builder. THE IRON TRADE REVIEW is the logical vehicle to carry your advertising to those trades.

CLEVELAND, OHIO, JUNE 24, 1915

THE IRON TRADE REVIEW

A weekly publication devoted to the Iron, Steel, Machinery and Foundry Industries of the United States and Canada.

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In This Issue

PAGE

IRON AND STEEL MARKET REVIEW.....1287

THE OPEN HEARTH.....1288

IRON AND STEEL MARKETS.....1290

A REAGENT FOR MACROSCOPIC ETCHING 1303

An interesting method of examining structure of steel without recourse to the microscope, involving use of molten zinc.

SURFACE DECARBURIZATION OF STEEL..1305

How microscope can be used to determine quantity of surface to be removed to eliminate decarburization.

FINISHING TEMPERATURES OF RAILS..1307

A defence of the shrinkage test required by specifications of American Society for Testing Materials — Pyrometer measurements impracticable.

MAINTAINING GALVANIZING STANDARDS 1310

Details of a new method of determining the amount of the spelter coating on sheets and wire.

EFFECT OF HEAT TREATMENT ON AXLES 1311

Interesting results of an investigation to increase the strength of axle shafts for motor trucks—Effect of heat treating.

HOW HUMIDITY AFFECTS LEATHER BELT 1315

Details of experiments made on the action of leather belts during changes in relative humidity—Results obtained.

MAKING MONEY FROM FURNACE SLAG.1318

Description of a new method of handling and marketing blast furnace slag using twin beds and a patented chain system.

PROGRESS IN BLAST FURNACE PRACTICE.1320

Results on an efficiency test on hot blast stoves—Use of hot and dry blast—Future development of blast furnaces.

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"Safety First"—Bah!

You're not fooling anybody, not even yourself. MONEY FIRST, that's you.

Look at those elevators you have.

Why did you buy them?

Because they were "SOMETHING CHEAPER."

You would not be allowed to run them an hour if your state had elevator laws like Massachusetts, New Jersey, Wisconsin, and other states.

Even now it is against the law to use them for passenger service. Because sooner or later they are bound to hurt somebody.

You pay $1,000 to $5,000 for an automobile to "sport" with and meet your "women folks'" social ambitions.

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Automobile runs three or four years if you have luck.

Ridgway elevator runs forever whether you have luck or not.

If you will look around you will find the great concerns which employ high grade engineering talent are installing these machines as fast as we can make them.

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2. **Absolutely Fool Proof.**
3. **No repairs.**
4. **Always goes.**
5. **Goes when the engine is shut down.**

NO PAY UNTIL IT MAKES GOOD.

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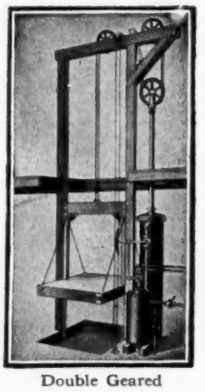

Double Geared

CRAIG RIDGWAY & SON
Coatesville, Pa.
Elevator makers to folks who know

"—but they last to beat Sam Hill"

"Ain't it a lot more satisfying, a heap more enjiable to work with good equipment—and don't fine tools make you work better? Seems to give a dignity to the job—and gets you a feelin' like you was a regular master workman in your profession. Like havin' yer shoes shined good an' black when ye go to church with your wife on a Sunday.

"Self respect is the beginnin' of good workmanship and good livin' and everything else that's good, and always will be. An' when you come to figure it out, first class paraphernalia is the first step to self respect and to self-respectin' work—and in the long run it's the cheapest.

"Remember *that* when you come to buyin' barrows—and get Sterlings. Sure they cost more, they're built better—but they last to beat Sam Hill."

—TIM TRUNDLE

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From a dealer in Seattle who carries a large stock of Sterling Barrows:

"We wish to advise you that we cannot speak too highly of the "Sterling Wheelbarrow". We have sold your barrows exclusively for the last two years and during that time have received absolutely no complaints as to their quality, workmanship and length of service, which of itself is sufficient recommendation. Among our customers there is no person but what acknowledges them to be the best barrow on the market.

The Sterling Barrow or Cart for your particular service is described in Catalog No. 24. You'll find a copy interesting.

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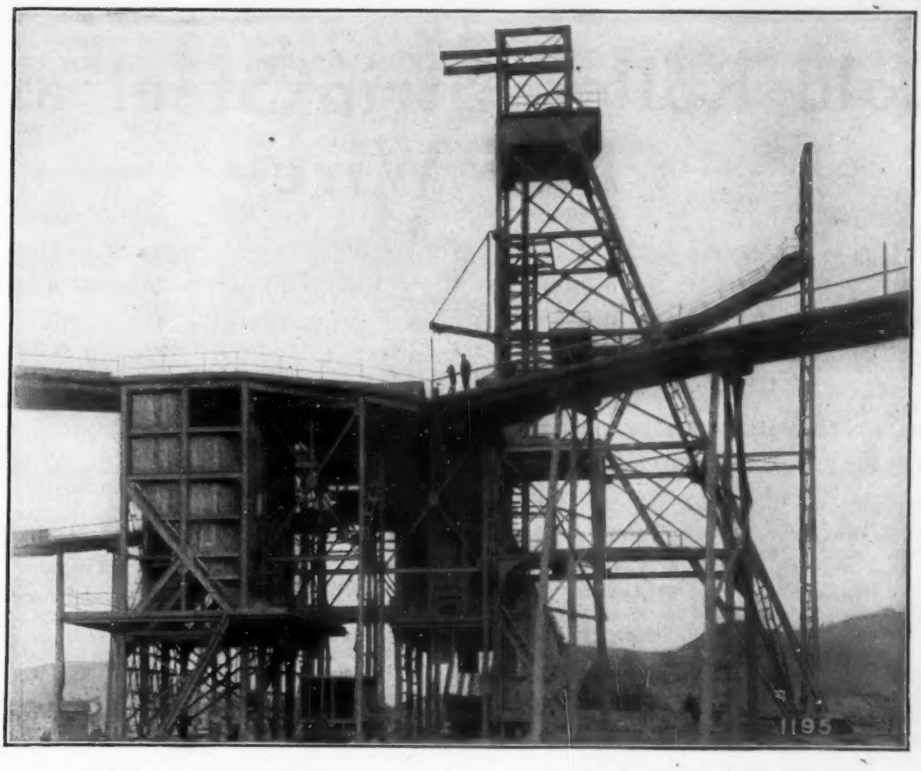
HUDSON TERMINAL-30 CHURCH STREET NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS



Headframe, Stock Pile Trestle with extra shipping pockets for Section 16 Shaft of Lake Superior Mine, Ishpeming, Mich.

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Works: Wheeling, W. Va.

General Offices, Steubenville, O.

Works: Steubenville, O.

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There is a large stock of Cold Rolled Strip Steel in stock in the Ryerson Warehouses at all times. The fact that the trade could secure this steel in all stock sizes, in hard, half hard and dead soft qualities immediately, has made Joseph T. Ryerson & Son headquarters for this product as well as all similar plain and special steels. We are also in position to offer quick mill shipments in special lengths, widths and tempers.

We maintain a complete stock of all iron and steel products, including the following, all ready for immediate shipment:

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MILWAUKEE, WISCONSIN.

White Pine Pattern and Templet Lumber

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Let us fill your requirements. You'll be pleased with "Johnson" Service.

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Opportunities

Men Wanted
Minimum, 50 words, $1.00. Each additional word, 2c. All capitals, 50 words, $1.50. Each additional word, 3c.

Position Wanted
Minimum, 25 words, 50c. Each additional word, 2c. All capitals, 25 words, 75c. Each additional word, 3c.

Miscellaneous Classified
Minimum, 25 words, $1.00. Each additional word, 4c. All capitals, 25 words, $2.00. Each additional word, 8c.

Remittance should be made to cover eight (8) words for address if box number is used.

PUBLIC SALE—ALTON STEEL COMPANY

Public Auction on June 29th, 1915, at 11 o'clock A. M., on the premises of the ALTON STEEL COMPANY at Alton, Ill.

ALL OF THE PROPERTY AND ASSETS OF THE ALTON STEEL COMPANY, CONSISTING OF

A tract of land containing forty-four and two-tenths (44.2) acres, more or less, situated in the South half of Section Number eighteeen (18), in Township Number five (5) North, Range Number nine (9) West of the Third Principal Meridian, in the County of Madison and State of Illinois. HAVING ERECTED THEREON

OPEN HEARTH STEEL PLANT

Consisting of two 40-ton furnaces, charging machine, 50-ton ladle crane, one yard crane and all accessory equipment.

BLOOMING MILL

One 32-inch Blooming Mill with reversing engine, tables, heating furnaces, ingot charging machine, etc.

BILLET MILL

One 18-inch Billet Mill, consisting of two three-high tandem stands with necessary tables, shears, run-outs and electric drive, together with overhead cranes, billet storage yard, etc.

FINISHING PLANT

One 10-inch mill, consisting of three three-high stands and two two-high stands with Morgan Continuous Roughing Train and Morgan Continuous Heating Furnace, together with electric drive, spare rolls and accessories.

One 8-inch mill, consisting of four three-high stands and two two-high stands with electric drive, heating furnaces, spare rolls and accessories.

BUILDINGS

OPEN HEARTH, BLOOMING MILL, 18-INCH MILL, 10-INCH MILL, 8-INCH MILL, MACHINE SHOP, PICKLE BUILDING, GALVANIZING MILL, FORGE SHOP, EIGHT ROOM OFFICE BUILDING, TIMEKEEPER'S BUILDING, PRODUCER HOUSE BUILDINGS, ETC.

TOGETHER WITH BOILER PLANT, ELECTRIC STATION, WATER SUPPLY PLANT, TRACKS, LOCOMOTIVE, LOCOMOTIVE CRANE, GALVANIZING PLANT, TOOLS, AND MUCH OTHER EQUIPMENT.

Together with the following raw material and stores: Finished and semi-finished products. Pig Iron, Butts, pit and mill scrap, bloom and billet crops, heavy melting scrap, shovelling steel, etc., iron ore, ferro-silicon, limestone, dolomite, magnesite, fluor-spar, silica sand, sleeves, nozzles, truss rods, billets, ingots, spare rolls, hoops, bands, etc. ALSO office equipment and all other property on the above premises. The property has good railroad facilities.

The properties so to be offered for sale will be sold subject to the lien of the first mortgage dated July 1st, 1913, made by the Alton Steel Company to the Alton Banking and Trust Company, Trustee, to secure an issue of bonds of the par value of three hundred thousand ($300,000) dollars, all of which are issued and outstanding with interest due thereon from July 1st, 1914. Satisfactory arrangements can be made with the bond holders for a continuation of this mortgage.

TERMS OF SALE

The sale shall be upon the following terms of payment: Ten (10) per cent to be paid in cash at the time the property is knocked down and the remainder of the purchase price shall be paid within thirty (30) days after the making of said sale. The property is subject to a second mortgage of, $350.000 with interest from May 1st, 1914, and sufficient must be bid to pay off this mortgage with accrued interest.

If any bidder fails to make good his bid, the properties may again be put up for sale and the bidder so defaulting will be held for the difference between his bid and the price at which the property is finally sold if there be any.

Any information desired will be furnished by the ALTON STEEL COMPANY at its office in Alton, Ill.

The owners reserve the right to reject any and all bids. Address: M. L. Mozier, *Secretary*

ALTON STEEL COMPANY, Alton, Illinois

Sites

NOTICE TO MANUFACTURERS

FACTORY OR WAREHOUSE property for rent, can give two and a half or seven and a half year lease, on very low rental basis. Building 70 x 120, three floors and cement basement. Contains steam engine and two elevators. Building stands alone having light on four sides. Can be approached by two streets and two alleys, equipped with sprinkler system. Building was occupied before by factory, has lockers and toilet on each floor and other factory equipment therein. Weil & Co., 87 Michigan Ave., Detroit, Mich.

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Stamping or Forming Work Done

Send us your inquiries. We have pleased others, we will satisfy you. Prices reasonable.

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Jewett, Ohio

NOVELTIES made of STEEL

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Estimates cheerfully given.
Work shipped on approval.

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Two Rivers, Wis.

Contract Work

A MODERN FACTORY LOCATED IN one of the principal railroad centers of the Middle West, is in a position to accept a liberal amount of work in Forge Shop, Machine Shop, Wood Work Shop and Gray Iron Foundry. Owing to the slack season, close figures and prompt delivery can be made. Representative will call on request. Address Box 449, THE IRON TRADE REVIEW, Cleveland, O.

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WANTED: — SECOND-HAND DELANO or equal, pulley molding machine for pulleys 38 to 48-inch, inclusive; also one pulley turning lathe for either 20 to 30-inch pulleys. Both of the above machines to be in first-class condition and at a reasonable price. Address Box 458, THE IRON TRADE REVIEW, Cleveland, O.

Classified Advertisements continued on following page

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RATES
1 inch, 1 time, $2.50
2 inches, 1 time, $4.75
3 inches, 1 time, $6.75
10% discount on 4 time orders.

Wanted and For Sale
"The rendezvous of frugal dealers"

IMPORTANT
Copy must be received on Thursday preceding date of publication. Write us for rates on continuous ads—they will interest you.

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EMBOSSED LETTERHEADS BOND Paper, 1,000 $3.75. Sample Book Free. TURNER & DUNLAP, WILKES-BARRE, PA.

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FOR SALE: — COAL AND VIRGIN timber lands, lots ranging from 1,000 to 30,000 acres in West Virginia or Eastern Kentucky. Address A. M. Foose, Box 673, Huntington, W. Va.

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RICH ZINC AND LEAD LANDS FOR SALE.

In Boone, Marion, Newton Counties, Arkansas, and Taney County, Missouri, 3,500 Acres. Selected 15 Years Ago in the Richest Mineral Belt by Competent Prospector. Address C. M. Fenton, Box 1381, Columbus, O.

MODERN FOUNDRY AND MACHINE shop for sale. The business and property of the Nampa Iron Works, at Nampa, Idaho, for which sealed bids will be received on or before July 14, 1915. List of property and information obtained and bids received by the secretary. Rights reserved to reject any or all bids. E. R. Brace, secretary, Nampa, Idaho.

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he did not know us before. We buy, sell, exchange, rent and repair
Motors and Dynamos
Over 1200 machines ready for actual delivery. Get our prices
All machines *positively guaranteed* for one year
Phone 8750 8751 8689 Canal
Nathan Klein & Co.
208 Centre St. New York

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One Oliver Double Head opening, Die Bolt Cutter, ¼" to 1" Capacity, with counter shaft—in fair good condition.

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FOR SALE

Delaware River property, 10 acres of land, buildings erected recently, equipment, plenty of labor, deep water, three railroads, excellent opportunity to purchase a property that can be operated immediately.

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TURRET LATHES

Five 21" Gisholt.
Three 24" Gisholt.
One 24" American.
One 28" Gisholt.
One 32" Bullard.
One 40" Grant.
One 22" x 7' Potter & Johnston semi-automatic.
2¼" Gridley Full Automatic.
21" x 7' Universal.
22" x 6' Draper.
16" x 6' Draper.
Four Brown & Sharpe old style Automatics, 5-16" capacity.
Three American Fox Monitor Brass Lathes.
Warner & Swasey Universal Brass Lathe.
Two 16" x 6' Pratt & Whitney.
Cleveland Automatic 1¼" capacity.
Cleveland Automatic 5-16" capacity.
Six No. 1 Pratt & Whitney.

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For Immediate Shipment

We have in stock ready for immediate shipment the following Steam Hammers:

600 lb. Single Stand
1250 lb. Single Stand
2000 lb. Single Stand
2000 lb. Double Stand

These are new hammers and complete with anvil block and dies. If interested a very attractive quotation will be given on application.

The Morgan Engineering Co.
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Steam Turbo Generators—3 Phase-60 Cycle
1000kw Westgh. Parsons Low Pressure.
625kw Gen'l Elect. High Pressure
500kw Westgh. Parsons High Pressure

"Engine Driven Generators"
250kw Western Electric with 4 cyl. Vertical "Model" Gas Engine.
150kw Western Electric with 4 valve Erie City Steam Engine.
125kw Western Electric with Skinner Auto. Steam Engine.

"250 Volt Direct Current"
400kw Fort Wayne with Russell Horiz. Auto. Steam Engine.
200kw Westinghouse with Harrisburgh 4 valve Auto. Steam Engine.
100kw Ridgway with McEwen Auto. Steam Engine.

"125 Volt Direct Current"
25kw Westinghouse with Harrisburgh Fleming Auto. Steam Engine.

"Alternating Current Motors" "220-440 and 2300 Volts"
400hp Gen'l Elect. "M" Speed 720
250hp Gen'l Elect. "K" Speed 585
100hp Gen'l Elect. "K" Speed 720
75hp Westgh. Elect. "CCL" Speed 685

"125 and 250 Volts Direct Current"
2-100hp Westinghouse "S" Speed 625
75hp Westinghouse "M" Speed 650
50hp Westinghouse "M" Speed 650

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No. 5 Worthington Centrif. Pump with 15hp Motor direct connected.
5 Ton Single Friction Drum Motor Driven Hoist.
6 Ton Sprague 250 V. Mono. Rail Hoist
Motor Driven Exhaust Fans and Pumps
Motor Generator Sets Extra Armatures

THE LARGEST ACTUAL STOCK OF ELECTRICAL BARGAINS between NEW YORK and CHICAGO.

If you wish to buy or sell write

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PITTSBURGH, PA.

FOR SALE

Boilers all sizes. Motors all currents.
Engines all kinds.
Steam, Gas and Electrical Machinery

EDGAR M. MOORE & CO.
Pittsburgh, Pa.

Classified Advertisements continued on following page

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(Continued)

Power Plant Equipment

at less than ⅓ of original cost

All modern equipment in first-class working order.

Electric generating units, fans, engines, compressors, hoisting engines, pumps, etc.

Write for full list.

NEW RIVER COMPANY
Equipment Sales Department
Macdonald **West Virginia**

Special Machinery Offered

120" K. W. Westinghouse alternated, 220 volt, 3 phase.

55 K. W. 120 volt, New England Generator, 650 R. P. M. complete.

One number 12 x 16 automatic center crank engine with 34 x 16 pulley, 54 x 15 balance wheel.

37½ K. W. D. C. 115 V. Keystone Generator with Rheostat.

84" Foundry Cupola.
(2) No. 6 Green Foundry Blowers.
1 No. 6 Garden City Blower.
1 No. 3000 Board Lift Drop Hammer.
1 No. 10 Osborn Jolt Rockover Molding Machine.

1 Power Screw Nipple Assembling Machine.

1 Automatic double action reaming and tapping machine.

1 Triple Power Pump radiator testing apparatus.

1 Lot of patterns for steam and hot water radiators.

68 Arc Lights.
3 Edison Dictating Machines.
1 Sheet Steel Oiling Machine.
1 Push Nipple Radiator Assembling Machine.
1 26" Drum Sand Machine.

220 Volt Motors

20 H. P., D. C. General Electric.
10 H. P. Westinghouse, R. P. M. 1250.

Address Box 465
THE IRON TRADE REVIEW
Cleveland, O.

War Orders Have Depleted Machinery Stocks.

Do you realize it will be months before orders can be caught up?

Second Hand Equipment Eagerly Sought To Fill Gap.

The demand for second-hand machinery is greater than ever before.
——It is like gold in the bank.

Sell your idle or stored away equipment through a little ad in these columns.

REAL BARGAINS

1—Clizbe Grinder and Buffing Machine, new, will swing about 10" emery wheels.	$15.00
1—Motor Driven Eager Polishing Machine	200.00
1—No. 6T Grinder and Countershaft, new.	42.50
1—Second hand Grinder Overhead Support	5.00
1—Second hand Junior Core Oven, almost as good as new	40.00
1—Second hand Band Saw, single speed.	40.00
1—Second hand 23 x 34 Brass Furnace. This furnace is practically as good as a new one	20.00
1—Odd size Brass Furnace suitable for No. 50 pot with 27" high shell. This is a special furnace	15.00
1—Second hand Wood Tank, 40" long, 26" deep, 26" wide	6.00
1—Wood Tank, new, 36" long, 24" wide, and 24" deep. This tank has never been used but is a little shopworn	5.00
1—Piece of Iron Grating for use in front of brass furnaces, 72" long, 35" wide, will sell at per square foot. When new this cost $1.25 per ft.	1.00
10—Iron Flasks, 12½ x 18 x 5	2.00
17—Iron Flasks, 11 x 14 x 6, each	2.00
12—Sterling Wheelbarrow, Wheel Flasks, 12 x 18 x 8	2.00
6—12½ x 18 x 6 Sterling Wheelbarrow Flasks, each	2.00
1—Second hand Middleditsch Tilting Tumbling Barrel. This barrel has been completely overhauled and is as good as a new barrel	65.00
1—Second hand Steam Boiler, suitable for heating 100 gallons of water to boiling point	35.00
3—Second hand Athey Polishing Lathes each	50.00
1—New No. 5 Dust Collector	42.50
1—No. 5 Stewart soft metal Melting furnace for aluminum with one extra pot, furnace equipped for artificial gas. Used, but in good condition	50.00
1—No. 35A Stewart Metal Melting Furnace equipped for artificial gas. Used, but in good condition	40.00
1—No. 80A Stewart Metal Melting Furnace, equipped for artificial gas. Used, but in good condition	75.00

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Detroit

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Stowell Manufacturing & Foundry Co.'s large plant at Milwaukee. The property comprises a site of 13 acres and all the necessary buildings for an up-to-date malleable and gray iron foundry, together with a large machine shop. The total number of square feet in the larger buildings is 100,396, which is exclusive of the barn, sand sheds, etc.

STOWELL MANUFACTURING & FOUNDRY COMPANY, MILWAUKEE
F. L. SIVYER, Trustee

"BUFLOKAST"

The Guarantee of Highest Quality

"BUFLOKAST" is a name that assures you both quality of product and superiority of service.

It means Laboratory Controlled Foundry Methods ---methods combining unsurpassed foundry facilities; most thoroughly equipped and up-to-date chemical and physical testing laboratories; and a model organization of experienced and scientific metallurgists.

By virtue of this incomparable combination, we are able to produce on any scale, the metals which laboratory research and manufacturing experience have proved to be the most suitable for any particular purpose.

The reputation of "BUFLOKAST" service and quality is unblemished.

We can greatly reduce your costs and worries.

WRITE US

Buffalo Foundry & Machine Co.
50 Winchester Ave., Buffalo, N. Y.

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NEW YORK
CHICAGO PITTSBURG

IN ALL CLASSES OF POWERFUL MACHINERY, FREEDOM FROM REPAIR BILLS IS THE IMPORTANT CONSIDERATION. STEEL CASTINGS OF INFERIOR QUALITY IN SUCH WORK ARE EXPENSIVE AT ANY PRICE. QUALITY, NOT FIRST COST, SHOULD BE THE DETERMINING FACTOR IN PURCHASING STEEL CASTINGS FOR MACHINERY OF HIGH CAPACITY.

MACHINE TOOLS

NILES CRANES BEMENT HAMMERS

BUILT BY

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25 VICTORIA STREET, LONDON

Boston Philadelphia Pittsburgh Chicago St. Louis Birmingham, Ala.

Write to nearest office for catalogues.

Say you saw it in THE IRON TRADE REVIEW

Index to Advertisements

See "WHERE-TO-BUY" for classified-by-products list of advertisers

The star (*) indicates that the advt. appears alternate weeks, the dagger (†) once a month.

A

Abramsen Engineering Co.... 134
Acme Steel & Malleable Iron Works 119
†Adrian Steel Casting Co.... —
Aldrich Pump Co..... 18
Allegheny Steel Co..... 137
*Allen, John F., Co..... 18
†Allen & Curtiss Co. ..... —
Alliance Machine Co..... 131
Alliance Structural Co..... 139
Amer. Bridge Co. of N. Y... 33
American Car & Ship Hardware Mfg. Co..... 121
Amer. Iron & Steel Mfg. Co. 17
*American Refractories Co... 145
Amer. Sheet & Tin Plate Co. 6
American Steel Foundries.. 112
American Steel & Wire Co... 2
Andrews Steel Co..... 8
†Angle Steel Stool Co..... —
†Arcade Mfg. Co..... —
†Armstrong Cork & Insulation Co. ..... —
Atlas Car & Mfg. Co..... 147
Atlas Steel Casting Co.....1344b
Ayer & Lord Tie Co.....1339

B

†Baird Machinery Co..... —
*Baker Bros. 115
*Barnett, G. & H., Co..... 141
Barnum Richardson Co..... 142
†Barr, H. Edsil..... —
Baush Mch. Tool Co..... 115
†Beaudry & Co., Inc..... —
Belle City Mall. Iron Co.... 117
Bellefontaine Bridge & Steel Co. 138
*Bertsch & Co. ..... —
Bethlehem Steel Co..... 147
*Bettcher Mfg. Co..... 141
Bilgram Machine Works..... 135
Birdsboro Steel Fdy. & Mch. Co. 18
Blackwell, Geo. G., Sons & Co., Ltd. 142
Blair Engineering Co..... 138
Blake & Johnson Co..... 134
Bliss, E. W., Co. 27
†Blystone Mfg. Co..... —
†Bourne-Fuller Co. ..... —
Breitung, E. N., & Co..... 144
Brier Hill Steel Co..... 137
†Brown Hoisting Mchy. Co.. —
*Brown Instrument Co..... 28
†Brown-Wales Co. ..... —
Browning Co. 130
Buffalo Fdy. & Mch. Co..... 112
*Buffalo Steel Co..... —

C

Cambria Steel Co..... 10
Campbell Wire Specialty Wks. 141
Canton Sheet Steel Co..... 137
*Carbon Steel Co..... 12
Carnahan Tin Plate & Sheet Co. 1344c
Carnegie Steel Co..... 11
Central Tube Co..... 139
*Chalmers & Williams..... —
Chambersburg Engrg. Co.... 135
Champion Mch. & Forg'g Co. 121
Champion Rivet Co..... 2
Chapman Engineering Co. .. —
Chase Fdy. & Mfg. Co..... 133
Chicago Rawhide Mfg. Co... 2
*Chisholm-Moore Mfg. Co.... 132
†Cincinnati Electrical Tool Co. —
*Cincinnati Iron & Steel Co. —
†Cincinnati Milling Mach. Co. —
†Cincinnati Planer Co..... —
†Clark, Chas. J..... —
Clearfield Fire Brick Co..... 145
*Cleveland & Buffalo Transit Co. ..... —
Cleveland Pneumatic Tool Co. 114
Cleveland Punch & Shear Works Co. 27
†Columbia Steel & Shaft'g Co. —
†Columbus Forge & Iron Co. —
Columbus Iron & Steel Co.. 144
Columbus Mall. Iron Co....1344b
Cook, Asa S., Co..... 134
Cooper, C. & G.,Co..... 141
*Crocker-Wheeler Co..... —
*Crowley, John A., Co..... 13
Cumberland Steel Co..... 136
†Cyclops Foundry Co..... —

D

Dake Engine Co..... 131
Danville Malleable Iron Co.1344c
Dart, E. M., Mfg. Co..... 139
Davison, Allen S., Co..... 141
Dayton Steel Fdy. Co..... 117
Deming Co. 2
†Detroit Electric Welder Co. —
Detroit Hoist & Mch. Co.... 130
†Disston, Henry, & Sons Co.. —
Dixon, Joseph, Crucible Co.. 141
†Domhoff & Joyce Co..... —
*Dover Fire Brick Co..... 145
Drop Forging Co. of N. Y... 121
†Duer Spring & Mfg. Co.... —

E

Eaton, Rhodes & Co..... 144
Eccles, Richard, Co..... 121
†Economy Drawing Table Co. —
Eichleay, John Jr., Co..... 137
*Electric Controller & Mfg. Co. ..... —
Erdle Perforating Co..... 136
Erie Foundry Co..... 121
Erie Malleable Iron Co..... 117
†Espen-Lucas Machine Wks.. —
Euclid Crane & Hoist Co.... 132

F

Falk Co. 135
Falls Rivet Co.....1344c
†Farrell Fdy. & Mch. Co... —
Fawcus Machine Co..... 135
†Federal Steel Fdy. Co..... —
Firth-Sterling Steel Co..... 3
†Flagg, Stanley G., & Co.... —
Franklin Steel Works..... 12
*Freeman, S., & Sons Mfg. Co. ..... —

G

Garrison, A., Fdy. Co..... 134
†General Chemical Co..... —
General Drop Forge Co..... 121
General Electric Co..... 23
General Malleable Co.....1344c
Globe Iron Co..... 142
†Globe Steel Co. ..... —
†Gordon Sand Co., Inc..... —
Graton & Knight Mfg. Co... 141
Green Engineering Co..... 141
Groton Bridge Co. 117

H

Hagan, Geo. J., Co..... 138
Hanna, M. A., & Co..... 143
Harbison-Walker Refractories Co. 145
Hartman, W. E. 138
†Harvey, Arthur C., Co..... —
Hauser-Stander Tank Co..... 136
Hendrick Mfg. Co..... 136
Hilles & Jones Co..... 135
Hillman, J. H., & Sons Co... 15
†Hinman, D. A., & Co..... —
†Hitt, S. E..... —
Horsburgh & Scott Co..... 135
*Howard Testing Laboratories —
Hunt, Robert W., & Co.... 138
†Hyde Park Fdy. & Mch. Co. —

I

Illinois Malleable Iron Co...1344b
Illinois Steel Co..... 4
Illinois Steel Co., Warehouse Dept. 14
Illinois Steel Warehouse Co... 14
Industrial Works..... 133
Ingalls-Shepard Forging Co... 121
*Inland Steel Co..... —
*International Oxygen Co.... 141

J

Johnson Engineering Works.. 134
Johnson Lumber Co..... 34
†Jones & Lamson Mach. Co... —
Jones & Laughlin Steel Co... 10

K

Kennedy - Stroh Corporation, Best Mfg. Dept..... 139
Kier Fire Brick Co..... 145
Kilby Mfg. Co..... 136
†Kissel Motor Car Co..... —
Koppers, H., Co.....Front cover
†Kratzer, W. N., & Co..... —
Kropp Forge Co..... 121

L

La Belle Iron Works.....7, 34
Lackawanna Steel Co..... 14
Laclede Steel Co..... 137
†Lakeside Mall. Castings Co. —
†Landis Machine Co..... —
†Landis Tool Co..... —
Laughlin, Alex., & Co..... 138
Leard, Wm. E.....1344c
†Lehigh Clutch Co. ..... —
Linde Air Products Co..... 29
Lockhart Iron & Steel Co... 15
Long & Allstatter Co..... 135
*Louisville Fire Brick Works 145

M

†McCalla, Harold Co..... —
McClintic-Marshall Co. 137
McClure, G. W., Son & Co.. 138
McKee, Arthur G., & Co.... 138
McKeefrey & Co. 144
McMyler Interstate Co..... 133
Mackintosh, Hemphill & Co.. 20
Manning, Maxwell & Moore, Inc. 130
Marion Mall. Iron Works... 117
*Marshall Foundry Co..... 119
*Massillon Rolling Mill Co.. 137
Mesta Machine Co. 21
†Michigan Bolt & Nut Wks.. —
Michigan Wood Preserv. Co.. 137
Milton Mfg. Co.*..... 136
Missouri Mall. Iron Co..... 115
Mitchell-Diggins Iron Co..... 144
†Mitts & Merrill..... —
†Modern Tool Co..... —
*Mohr, J. J., & Son..... 144
†Moline Malleable Iron Co.... —
Moltrup Steel Products Co... 13
Moore, Edgar M., & Co..... 110
Morgan Construction Co..25, 114
Morgan Engineering Co..... 130
Morse Twist Drill & Mach. Co. 115
Mt. Vernon Bridge Co..... 135
Muskegon Boiler Works..... 135

N

National Foundry Co..... 119
National Machinery Co..... 136
National Mall. Castings Co... 119
*National Roll & Fdy. Co.... 134
National Transit Co..... 135
National Tube Co..... 139
†Newbold, R. S., & Son Co. —
*New Britain Mch. Co..... —
New Departure Mfg. Co..... 134
Newport Rolling Mill Co..... 7
New Process Gear Corp..... 135
*Newton Mach. Tool Works Inc. ..... —
New York Mchy. Exchange.. 110
Nicholson File Co..... 29
Niles-Bement-Pond Co.....112, 132
Northern Engineering Wks... 130
†Northwestern Mall. Iron Co. —
*Norton Grinding Co..... 19
Norwalk Iron Wks. Co..... 136
*Nuttall, R. D., Co..... —

O

Oglebay, Norton & Co..... 144
Ohio Wood Preserving Co... 137
Oliver Iron & Steel Co..... 16
Orton & Steinbrenner Co.... 133
*Otis Steel Co 1344b
Oxweld Acetylene Co..... 28

P

†Phillips & McLaren Co..... —
Phoenix Iron Works Co..... 134
Pickands, Brown & Co..... 144
Pickands, Mather & Co..... 146
†Pittsburgh Anneal'g Box Co. —
†Pittsburgh Cold Rolled Steel Co. ..... —
*Pittsburgh Iron & Steel Foundries Co. 134
Pittsburgh Malleable Iron Co. 117
Pittsburgh Piping & Equipment Co. 139
Pittsburgh Valve, Foundry & Construction Co..... 139
Pittsburgh Wood Preserv. Co. 137
†Portsmouth Refractories Co. —
†Pridmore, Henry E..... —
Progressive Mfg. Co..... 17

Q

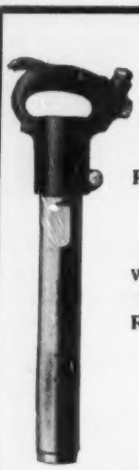
Quigley Furnace & Fdy Co.. 138

R

Racine Drop Forge Co..... 121
*Railway Materials Co..... —
Republic Iron & Steel Co... 9
†Richards, I. P., Co..... —
Ridgway, Craig, & Son..... 32
Riter-Conley Mfg. Co..... 3
†Rockford Bolt Co..... —
Rockford Drop Forge Co.... 121
Rogers, Brown & Co..... 144
*Ross-Meehan Foundry Co.... —
*Royal Ventilator Co. 141
Russell, Burdsall & Ward Bolt & Nut Co..... 17
Ryerson, Jos. T., & Son.... 34

S

St. Louis Steel Fdy..... 119
Samuel, Frank 144
Schwartz - Herrmann Steel Works ..... —
Scully Steel & Iron Co..... 14
Seaman-Sleeth Co. 134



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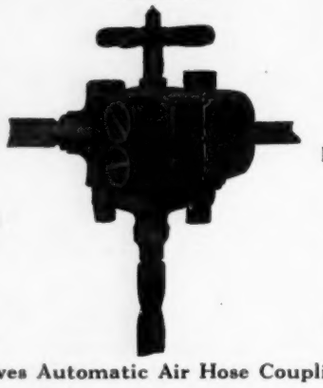

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*Searing & Coultas..... 138
*Semet-Solvay Co. ..... —
Seneca Iron & Steel Co..... 6
Sharon Fdy. Co. 1344b
Shaw Electric Crane Co..... 130
†Silberberg, Mortimer J..... —
*Sivyer Steel Casting Co.... 117
Smith Gas Power Co..... 25
Smith, Geo. H., Steel Casting Co. 119
Smythe, S. R., Co..... 138
Snyder, W. P., & Co..... 142
Soisson, Jos., Fire Brick Co. 145
†Southwark Foundry & Machine Co. ..... —
†Standard Bridge Tool Co.... —
†Standard Engineering Co.... —
*Standard Gauge Steel Co.... 13
†Standard Malleable Iron Co. —
Standard Tin Plate Co..... 137
*Stark Rolling Mill Co..... —
Steel Improvement Co.....1341
Sterling Wheelbarrow Co. .. 32
Stewart Iron Co., Ltd..... 144
Stowe-Fuller Co. 145
Strong Steel Foundry Co.... 119
Stupakoff, S. H..... 139
Superior Charcoal Iron Co... 144
*Swedish Crucible Steel Co.. 117
Swindell, Wm., & Bros..... 138

T

Taylor-Wharton Iron & Steel Co. 1344c
Tenn. Coal, Iron & R. R. Co. 146
Thew Automatic Shovel Co... 132
Thomas Furnace Co. 145
Thomas Iron Co..... 141
Thomson Electric Weld'g Co. 141
†Tilghman - Brooksbank Sand Blast Co. ..... —
†Titanium Alloy Mfg. Co.... —
Tod, Wm., Co..... 22
Tod-Stambaugh Co. 144
†Toledo Bridge & Crane Co... —
Toledo Electric Welder Co.... 26
Toledo Mach. & Tool Co.... 26
Torrington Mfg. Co..... 136
†Tretheway, Samuel, & Co., Ltd. ..... —
*Tropenas Converter Co..... 141
Trumbull Steel Co..... 137
Turner, Vaughn & Taylor Co. 16

U

†Underwood, H. B., & Co.... —
Union Drawn Steel Co..... 12
Union Mining Co..... 145
United Engrg. & Fdy. Co.... 27
†United States Cast Iron Pipe & Fdy. Co..... —
U. S. Metal & Mfg. Co..... 132
United Steel Co. 8
†Upson Nut Co. 148

V

†Valentine, M. D., & Bro. Co. —
†Van Dorn & Dutton Co.... —
†Vanes, John, Boiler Works. —
*Vulcan Iron Works 133

W

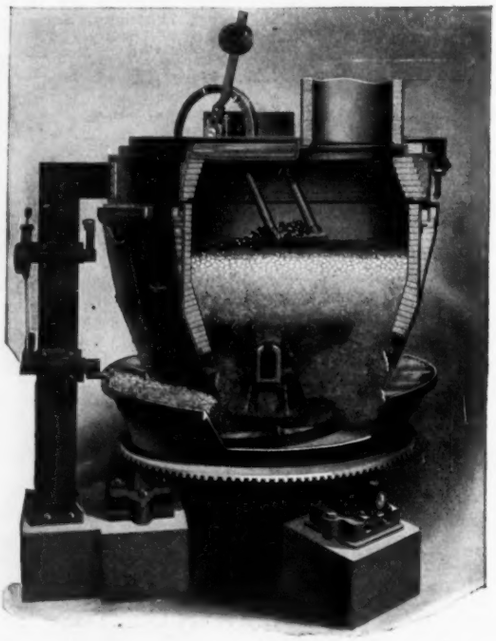
†Warner & Swasey Co. .... —
*Washington Coal & Coke Co. 142
Watson-Stillman Co. 135
†Weimer Chain & Iron Co.... —
†Weis Mfg. Co..... —
Wellman-Seaver-Morgan Co... 147
*West Leechburg Steel Co... —
West Steel Casting Co..... 117
Western Reserve Steel Co... 6
Westinghouse Electric & Mfg. Co. ..... —
Wheeling Mold & Fdy. Co.... 134
Whitaker-Glessner Co., Portsmouth Works 8
White, L. & I. J., Co..... 26
Whiting Fdy. Equipment Co. 131
†Wiggins, John B., Co..... —
Williams, I. B., & Sons..... —
†Williams Tool Co..... —
†Wisconsin Mall. Iron Co.... —
Wood, Alan Iron & St'l Co. 16
Wood, R. D., & Co..... 135
Worth Bros. Co..... 8
Wrought Washer Mfg. Co.... 18

Y

Youngstown Fdy. & Mch. Co. 134
Youngstown Iron & Steel Co. 3
Youngstown Sh't & Tube Co. 5

Z

Zanesville Malleable Co..... 117



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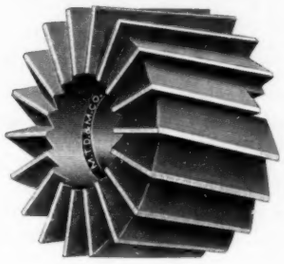

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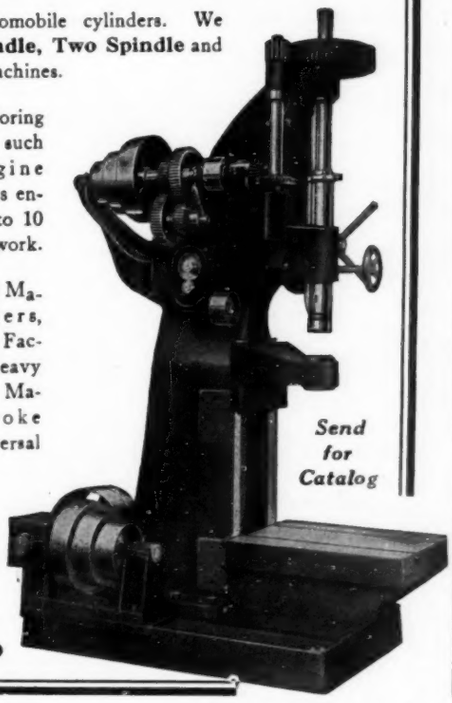

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Cincinnati Iron & Steel Co., Cincinnati, O.
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Harvey Co., Arthur C., Boston, Mass.
Illinois Steel Co., Chicago, Ill.
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Illinois Steel Warehouse Co., St. Louis, Mo.
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Lackawanna Steel Co., Buffalo, N. Y.
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Illinois Steel Co., Chicago, Ill.
La Belle Iron Works, Steubenville, O.
Lackawanna Steel Co., Buffalo, N. Y.
National Tube Co., Pittsburgh, Pa.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
Upson Nut Co., Cleveland, O.
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Freeman, S., & Sons, Mfg. Co., The, Racine, Wis.
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American Bridge Co., New York City.
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Milton Mfg. Co., Milton, Pa.
Muskegon Boiler Works, Muskegon, Mich.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Rockford Bolt Co., Rockford, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Ryerson, Jos. T., & Son, Chicago, Ill.
Scully Steel & Iron Co., Chicago, Ill.
Upson Nut Co., Cleveland, O.

BOLTS.
(Track.)
American Iron & Steel Mfg. Co., Lebanon, Pa.

BORING TOOLS.
Allen & Curtis Co., Mishawaka, Ind.

BOXES.
(Annealing.)
Mesta Machine Co., Pittsburgh, Pa.
Pittsburgh Annealing Box Co., Pittsburgh, Pa.
Pittsburgh Malleable Iron Co., Pittsburgh, Pa.
Pittsburgh Valve Foundry & Const. Co., Pittsburgh, Pa.
Swedish Crucible Steel Co., Detroit, Mich.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Zanesville Malleable Co., Zanesville, O.

BOXES.
(Shop.)
Sterling Wheelbarrow Co., Milwaukee, Wis.

BOXES.
(Sprue.)
Sterling Wheelbarrow Co., Milwaukee, Wis.

BRAKES.
(Electric.)
Electric Controller & Mfg. Co., Cleveland, O.
Toledo Bridge & Crane Co., Toledo, O.

BRAZING.
(Custom.)
Champion Rivet Co., Cleveland, O.
Racine Drop Forge Co., Racine, Wis.

BREAKERS.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

BREAKERS.
(Pig Iron.)
Brown Hoisting Machinery Co., Cleveland, O.

BREECHINGS.
Freeman, S., & Sons Co., The, Racine, Wis.

BRICK AND CLAY.
(Fire.)
Blackwell, Geo. G., Sons & Co., Ltd., Liverpool, England.
Clearfield Fire Brick Co., Clearfield, Pa.
Dover Fire Brick Co., Cleveland, O.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Kier Fire Brick Co., Pittsburgh, Pa.
Louisville Fire Brick Co., Highland Park, Ky.
Portsmouth Refractories Co., Portsmouth, O.
Soisson, Jos., Fire Brick Co., Connellsville, Pa.
Stowe-Fuller Co., The, Cleveland, O.
Union Mining Co., Mt. Savage, Md.
Valentine & Bros. Co., M. D., Woodbridge, N. J.

BRICK.
(Silica, Magnesia, Chrome.)
American Refractories Co., Chicago, Ill.
Soisson, Jos., Fire Brick Co., Connellsville, Pa.
Stowe-Fuller Co., The, Cleveland, O.

BRICK.
(Stove Blast Furnace.)
Kier Fire Brick Co., Pittsburgh, Pa.
Union Mining Co., Mt. Savage, Md.

BRICK INSULATION.
Armstrong Cork Co., Pittsburgh, Pa.

BRIDGES.
(Coal and Ore Handling.)
American Bridge Co., New York, N. Y.

BRIDGES, BUILDINGS AND VIADUCTS.
(Steel.)
Alliance Structural Co., Alliance, O.
American Bridge Co., New York, N. Y.
Bellefontaine Bridge & Steel Co., The, Bellefontaine, O.
Eichleay, John, Jr., Co., Pittsburgh, Pa.
Groton Bridge Co., Groton, N. Y.
McClintic-Marshall Co., Pittsburgh, Pa.
McMyler Interstate Co., Cleveland, O.
Mt. Vernon Bridge Co., Mt. Vernon, O.
Riter-Conley Mfg. Co., Pittsburgh, Pa.

BRUSHES.
(Dynamo.)
Dixon Crucible Co., Jos., Jersey City, N. J.

BUCKETS.
(Clam Shell, Grab or Orange Peel for Coal and Ore.)
Brown Hoisting Machinery Co., Cleveland, O.
Industrial Works, Bay City, Mich.
McMyler Interstate Co., Cleveland, O.
Orton & Steinbrenner Co., Chicago, Ill.

BUCKETS.
(Dredge.)
American Bridge Co., New York, N. Y.

BUCKETS.
(Elevator and Hoisting.)
Hendrick Mfg. Co., Carbondale, Pa.
Illinois Malleable Iron Co., Chicago, Ill.
Wellman-Seaver-Morgan Co., Cleveland, O.

BULLDOZERS.
Long & Allstatter Co., Hamilton, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Watson-Stillman Co., New York, N. Y.

BURRS.
(Rivet.)
Falls Rivet Co., Kent, O.
Upson Nut Co., Cleveland, O.
Wrought Washer Mfg. Co., Milwaukee, Wis.

BUSINESS CARDS.
(Engraved.)
Wiggins Co., John B., Chicago, Ill.

BUTTONS.
(Push.)
Electric Controller & Mfg. Co., Cleveland, O.

CABLEWAYS.
American Steel & Wire Co., Chicago, Ill.
Brown Hoisting Mchy. Co., Cleveland, O.
McClintic-Marshall Co., Pittsburgh, Pa.

CANS.
(Waste, Shop and Oil.)
New Britain Mach. Co., New Britain, Conn.

CAR WHEELS.
(Chilled.)
Barnum-Richardson Co., Lime Rock, Conn.

CARS.
(Annealing, Charging, Pig Iron, Etc.)
Atlas Car & Mfg. Co., Cleveland, O.
Chase Fdy. & Mfg. Co., Columbus, O.
Mesta Machine Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

CARS.
(Coal, Coke and Mining.)
American Bridge Co., New York, N. Y.
Atlas Car & Mfg. Co., Cleveland, O.

CARS.
(Electrically Driven.)
Atlas Car & Mfg. Co., Cleveland, O.

CARS.
(Industrial.)
Atlas Car & Mfg. Co., Cleveland, O.
Chase Fdy. & Mfg. Co., Columbus, O.
Whiting Fdy. Equipment Co., Harvey, Ill.

CASING.
(Oil and Gas.)
La Belle Iron Works, Steubenville, O.
National Tube Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, O.

CASTINGS.
(Air Furnace.)
Mesta Machine Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.

CASTINGS.
(Auto.)
Erie Malleable Iron Co., Erie, Pa.
General Malleable Co., Warren, O.

CASTINGS.
(Brass, Bronze and Aluminum.)
American Car & Ship Hdw. Mfg. Co., New Castle, Pa.
Arcade Mfg. Co., Freeport, Ill.
Dake Engine Co., Grand Haven, Mich.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

CASTINGS.
(Crucible Steel.)
Adrian Steel Casting Co., Adrian, Mich.
Sivyer Steel Casting Co., Milwaukee, Wis.

CASTINGS.
(Die.)
Atlas Steel Casting Co., Buffalo, N. Y.
Strong Steel Foundry Co., Buffalo, N. Y.

CASTINGS.
(Gear.)
Mesta Machine Co., Pittsburgh, Pa.
Strong Steel Foundry Co., Buffalo, N. Y.

CASTINGS.
(Gray Iron.)
American Bridge Co., New York, N. Y.
Arcade Mfg. Co., Freeport, Ill.
Barnum-Richardson Co., Lime Rock, Conn.
Birdsboro Steel Fdy. & Mach. Co., Birdsboro, Pa.
Buffalo Fdy. & Machine Co., Buffalo, N. Y.
Cyclops Foundry Co., Pittsburgh, Pa.
Dake Engine Co., Grand Haven, Mich.
Erie Foundry Co., Erie, Pa.
Farrell Fdy. & Machine Co., Ansonia, Conn.
Flagg, Stanley G., & Co., Philadelphia, Pa.
Groton Bridge Co., Groton, N. Y.
Kennedy-Stroh Corp., Best Mfg. Dept., Pittsburgh, Pa.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Marshall Foundry Co., Pittsburgh, Pa.
National Foundry Co., Erie, Pa.
Phoenix Iron Works Co., Meadville, Pa.
Quigley Furnace & Foundry Co., New York, N. Y.
Tod Wm., Co., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
U. S. Cast Iron Pipe & Fdy. Co., Burlington, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

CASTINGS.
(Gray Iron, Car and Locomotive.)
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
National Foundry Co., Erie, Pa.
Quigley Furnace & Foundry Co., New York, N. Y.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

CASTINGS.
(Gray Iron Machinery.)
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.

CASTINGS.
(Malleable.)
Acme Steel & Mall. Iron Works, Buffalo, N. Y.
Belle City Malleable Iron Co., Racine, Wis.
Columbus Malleable Iron Co., Columbus, O.
Danville Malleable Iron Co., Danville, Ill.
Erie Malleable Iron Co., Erie, Pa.
Flagg, Stanley G., & Co., Philadelphia, Pa.
General Malleable Co., The, Warren, O.
Illinois Malleable Iron Co., Chicago, Ill.
Lakeside Malleable Castings Co., Racine, Wis.
Marion Malleable Iron Works, Marion, Ind.
Missouri Malleable Iron Co., East St. Louis, Ill.
Moline Malleable Iron Co., St. Charles, Ill.
National Malleable Castings Co., Cleveland, O.
Northwestern Mall. Iron Co., Milwaukee, Wis.
Pittsburgh Malleable Iron Co., Pittsburgh, Pa.
Pittsburgh Valve Foundry & Const. Co., Pittsburgh, Pa.
Ross-Meehan Foundry Co., Chattanooga, Tenn.
Standard Malleable Iron Co., Muskegon, Mich.
Wisconsin Malleable Iron Co., Milwaukee, Wis.
Zanesville Malleable Co., Zanesville, O.

CASTINGS.
(Malleable, Car and Locomotive.)
General Malleable Co., The, Warren, O.
Lakeside Malleable Castings Co., Racine, Wis.
Marion Malleable Iron Works, Marion, Ind.
Missouri Malleable Iron Co., East St. Louis, Ill.
National Malleable Castings Co., Cleveland, O.
Pittsburgh Malleable Iron Co., Pittsburgh, Pa.
Pittsburgh Valve Foundry & Const. Co., Pittsburgh, Pa.
Zanesville Malleable Co., Zanesville, O.

CASTINGS.
(Manganese Steel.)
Strong Steel Foundry Co., Buffalo, N. Y.
Taylor-Wharton Iron & Steel Co., Highbridge, N. J.

CASTINGS.
(Open-Hearth Steel.)
American Steel Foundries, Chicago, Ill.
Atlas Steel Castings Co., Buffalo, N. Y.
Mesta Machine Co., Pittsburgh, Pa.
Sharon Fdy. Co., Sharon, Pa.
Strong Steel Foundry Co., Buffalo, N. Y.

CASTINGS.
(Semi-Steel.)
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
Pittsburgh Piping & Equip. Co., Pittsburgh.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

CASTINGS.
(Steel.)
American Steel Foundries, Chicago, Ill.
Atlas Steel Casting Co., Buffalo, N. Y.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Dayton Steel Foundry Co., Dayton, O.
Federal Steel Foundry Co., Chester, Pa.
Kennedy-Stroh Corp., Best Mfg. Dept., Pittsburgh, Pa.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
National Foundry Co., Erie, Pa.
National Malleable Castings Co., Cleveland, O.
Otis Steel Co., Cleveland, O.
Pittsburgh Iron & Steel Foundries Co., Pittsburgh, Pa.
Ross-Meehan Fdy. Co., Chattanooga, Tenn.
Sharon Foundry Co., Sharon, Pa.
Sivyer Steel Casting Co., Milwaukee, Wis.
Smith, Geo. H., Steel Casting Co., Milwaukee, Wis.

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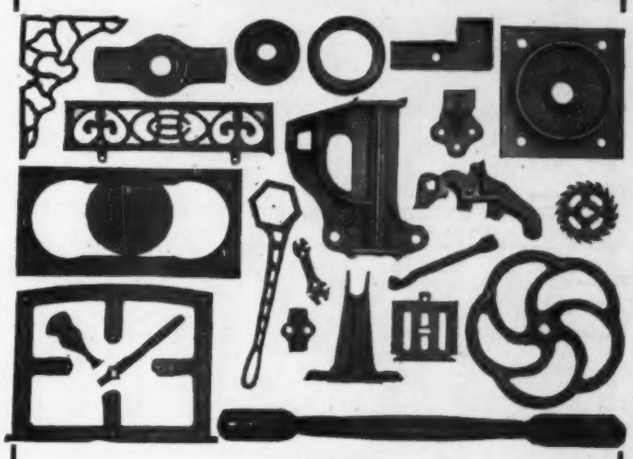

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(Continued.)
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Strong Steel Foundry Co., Buffalo, N. Y.
Swedish Crucible Steel Co., Detroit, Mich.
United Engineering & Fdy. Co., Pittsburgh, Pa.
West Steel Casting Co., Cleveland, O.
Wheeling Mold & Foundry Co., Pittsburgh, Pa.

CASTINGS.
(Steel, Car and Locomotive.)
American Steel Foundries, Chicago, Ill.
Atlas Steel Casting Co., Buffalo, N. Y.
National Foundry Co., Erie, Pa.
Otis Steel Co., Cleveland, O.
Strong Steel Foundry Co., Buffalo, N. Y.

CASTINGS.
(Steel Converter.)
Sivyer Steel Castings Co., Milwaukee, Wis.
West Steel Castings Co., Cleveland, O.

CASTINGS.
(Steel Electrical.)
Dayton Steel Foundry Co., Dayton, O.
National Malleable Castings Co., Cleveland, O.
Smith, Geo. H., Steel Casting Co., Milwaukee, Wis.
Strong Steel Foundry Co., Buffalo, N. Y.
West Steel Casting Co., Cleveland, O.

CASTINGS.
(Steel Machinery.)
American Steel Foundries, Chicago, Ill.
Mesta Machine Co., Pittsburgh, Pa.
Strong Steel Foundry Co., Buffalo, N. Y.

CASTINGS.
(Vanadium.)
Mesta Machine Co., Pittsburgh, Pa.
Strong Steel Foundry Co., Buffalo, N. Y.

CHAINS.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Weimer Chain & Iron Co., Lebanon, Pa.

CHAPLETS.
Champion Mch. & Forging Co., Cleveland, O.

CHARCOAL.
Hillman, J. H., & Sons Co., Pittsburgh, Pa.

CHEMICALS.
General Chemical Co., Cleveland, O.

CHEMISTS AND METALLURGISTS.
Howard Testing Laboratories, Lockport, N. Y.
Steel Improvement Co., Cleveland, O.

CHIMNEYS.
Riter-Conley Mfg. Co., Pittsburgh, Pa.

CHUCKS.
(Quick Change.)
Modern Tool Co., Erie, Pa.

CLAMPS.
National Tube Co., Pittsburgh, Pa.

CLAY.
(Fire Ground.)
Union Mining Co., Mt. Savage, Md.

CLEVISES.
American Bridge Co., New York, N. Y.

CLUTCHES.
Lehigh Clutch Co., Camden, N. J.

COAL.
Baird & West, Detroit, Mich.
Columbus Iron & Steel Co., Columbus, O.
Eaton, Rhodes & Co., Cincinnati, O.
Hanna, M. A., & Co., Cleveland, O.
Hillman, J. H., & Sons Co., Pittsburgh, Pa.
Pickands, Brown & Co., Chicago, Ill.
Rogers, Brown & Co., Chicago, Ill.
Semet-Solvay Co., Syracuse, N. Y.
Tenn. Coal, Iron & R. R Co., Birmingham, Ala.
Washington Coal & Coke Co., Dawson, Pa.

COAL CRUSHERS.
Orton & Steinbrenner Co., Chicago, Ill.

COAL TIPPLES.
American Bridge Co., New York, N. Y.
Eichleay, John Jr., Co., Pittsburgh, Pa.

COCKS, PLUG.
(Acid-Proof.)
National Tube Co., Pittsburgh, Pa.

COCKS.
(Tuyere.)
Kennedy-Stroh Corp., Best Mfg. Dept. Pittsburgh, Pa.

COILS.
(Pipe.)
National Tube Co., Pittsburgh, Pa.
Pittsburgh Piping & Equip. Co., Pittsburgh.

COKE.
Baird & West, Detroit, Mich.
Bourne-Fuller Co., Cleveland, O.
Eaton, Rhodes & Co., Cincinnati, O.
Hanna, M. A., & Co., Cleveland, O.
Hillman, J. H., & Sons Co., Pittsburgh, Pa.
McKeefrey & Co., Leetonia, O.
Mohr, J. J., & Son, Philadelphia, Pa.
Pickands, Brown & Co., Chicago, Ill.
Rogers, Brown & Co., Cincinnati, O.
Samuel, Frank, Philadelphia, Pa.
Semet-Solvay Co., Syracuse, N. Y.
Snyder & Co., W. P., Pittsburgh, Pa.
Stewart Iron Co., Ltd., Cleveland, O.
Tenn. Coal Iron & R. R. Co., Birmingham, Ala.
Washington Coal & Coke Co., Dawson, Pa.

COKE OVENS.
(By-Products.)
Koppers, H., Co., Pittsburgh, Pa.

COKE OVENS.
(Cross Regenerative.)
Koppers, H., Co., Pittsburgh, Pa.

COMMERCIAL GRINDING.
Norton Grinding Co., Worcester, Mass.

COMPRESSORS.
Southwark Foundry & Machine Co., Philadelphia, Pa.

COMPRESSORS.
(Air.)
General Electric Co., Schenectady, N. Y.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Mesta Machine Co., Pittsburgh, Pa.
Norwalk Iron Works Co., So. Norwalk, Conn.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

COMPRESSORS.
(Gas.)
Norwalk Iron Works Co., So. Norwalk, Conn.

CONDENSERS.
(Barometric.)
Mesta Machine Co., Pittsburgh, Pa.

CONDENSERS.
(Steam, Jet and Surface.)
Buffalo Fdy. & Machine Co., Buffalo, N. Y.
Cooper, C. & G., Co., Mt. Vernon, O.
Southwark Foundry & Machine Co., Philadelphia, Pa.

CONSTRUCTION.
(Concrete.)
Kratzer, W. N., & Co., Pittsburgh, Pa.

CONSTRUCTION.
(Steel and Iron.)
Alliance Structural Co., Alliance, O.
Eichleay, John Jr., Co., Pittsburgh, Pa.
Freeman, S., & Sons Mfg. Co., The, Racine, Wis.
Kratzer, W. N., & Co., Pittsburgh, Pa.
Muskegon Boiler Works, Muskegon, Mich.
Riter-Conley Mfg. Co., Pittsburgh, Pa.

CONTRACTORS.
(Piping.)
Kennedy-Stroh Corp., Best Mfg. Dept., Pittsburgh, Pa.
Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.

CONTROLLERS.
(Electric.)
Crocker-Wheeler Co., Ampere, N. J.
Toledo Bridge & Crane Co., Toledo, O.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

CONTROLLERS.
(Manual, Automatic, Machine Tool, Crane.)
Electric Controller & Mfg. Co., Cleveland, O.

CONVERTERS.
(Steel Casting.)
Tropenas Converter Co., New York City.
Whiting Foundry Equipment Co., Harvey, Ill.

CONVEYORS.
McMyler Interstate Co., Cleveland, O.

COOLERS AND DRYERS.
Freeman, S., & Sons Mfg. Co., The, Racine, Wis.

CORE MAKING MACHINES.
Pridmore, Henry E., Chicago, Ill.

COUPLINGS.
National Tube Co., Pittsburgh, Pa.

CRANES.
(Charging.)
Alliance Machine Co., Alliance, O.
Morgan Engineering Co., Alliance, O.
Niles-Bement-Pond Co., New York, N. Y.

CRANES.
(Electric Traveling.)
Alliance Machine Co., Alliance, O.
Brown Hoisting Machinery Co., Cleveland, O.
Browning Co., The, Cleveland, O.
Euclid Crane & Hoist Co., Euclid, O.
McMyler Interstate Co., Cleveland, O.
Morgan Engineering Co., Alliance, O.
Niles-Bement-Pond Co., New York, N. Y.
Northern Engineering Works, Detroit, Mich.
Ridgway & Son, Craig, Coatesville, Pa.
Shaw Electric Crane Co., New York, N. Y.
Toledo Bridge & Crane Co., Toledo, O.
Whiting Foundry Equipment Co., Harvey, Ill.

CRANES.
(Gantry.)
Alliance Machine Co., Alliance, O.
Brown Hoisting Machinery Co., Cleveland, O.
Industrial Works, Bay City, Mich.
McMyler Interstate Co., Cleveland, O.
Niles-Bement-Pond Co., New York, N. Y.
Toledo Bridge & Crane Co., Toledo, O.
Whiting Foundry Equipment Co., Harvey, Ill.

CRANES.
(Grab Bucket.)
Alliance Machine Co., Alliance, O.
Brown Hoisting Machinery Co., Cleveland, O.
Industrial Works, Bay City, Mich.
Niles-Bement-Pond Co., New York, N. Y.
Toledo Bridge & Crane Co., Toledo, O.
Whiting Foundry Equipment Co., Harvey, Ill.

CRANES.
(Hand Traveling.)
Euclid Crane & Hoist Co., Euclid, O.
Niles-Bement-Pond Co., New York, N. Y.
Toledo Bridge & Crane Co., Toledo, O.
Whiting Foundry Equipment Co., Harvey, Ill.

CRANES.
(Hand Trolley.)
Brown Hoisting Machinery Co., Cleveland, O.

CRANES.
(Hydraulic.)
Alliance Machine Co., Alliance, O.
Chambersburg Engrg. Co., Chambersburg, Pa.
Morgan Engineering Co., Alliance, O.

CRANES.
(Ingot Stripper.)
Alliance Machine Co., Alliance, O.
Niles-Bement-Pond Co., New York, N. Y.

CRANES.
(Jib.)
Alliance Machine Co., Alliance, O.
Brown Hoisting Machinery Co., Cleveland, O.
Industrial Works, Bay City, Mich.
McMyler Interstate Co., Cleveland, O.
Niles-Bement-Pond Co., New York, N. Y.
Ridgway & Son, Craig, Coatesville, Pa.
Shaw Electric Crane Co., New York, N. Y.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

CRANES.
(Locomotive.)
Brown Hoisting Machinery Co., Cleveland, O.
Browning Co., The, Cleveland, O.
Industrial Works, Bay City, Mich.
McMyler Interstate Co., Cleveland, O.
Orton & Steinbrenner Co., Chicago, Ill.
Wellman-Seaver-Morgan Co., Cleveland, O.

CRANES.
(Pneumatic.)
Detroit Hoist & Machinery Co., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

CRANES.
(Special.)
Alliance Machine Co., Alliance, O.
Brown Hoisting Machinery Co., Cleveland, O.
Euclid Crane & Hoist Co., Euclid, O.
Industrial Works, Bay City, Mich.
McMyler Interstate Co., Cleveland, O.
Shaw Electric Crane Co., New York, N. Y.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

CRANES.
(Steam and Pneumatic, Wire Mills.)
Morgan Construction Co., Worcester, Mass.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

CRANK SHAFTS.
Kropp Forge Co., Chicago, Ill.
Norton Grinding Co., Worcester, Mass.

CRUCIBLES.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

CRUSHERS.
Chalmers & Williams, Chicago Heights, Ill.

CRUSHERS.
(Disc.)
Chalmers & Williams, Chicago Heights, Ill.

CRUSHERS.
(Gyratory.)
Chalmers & Williams, Chicago Heights, Ill.

CRUSHERS.
(Jaw.)
Chalmers & Williams, Chicago Heights, Ill.

CUPOLAS.
Northern Engineering Works, Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

CUTTERS.
Landis Tool Co., Waynesboro, Pa.

CUTTERS.
(Milling.)
Morse Twist Drill & Mch. Co., New Bedford, Mass.

CUTTING.
(Electric Arc.)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CUTTING.
(Oxy-Acetylene Process.)
Linde Air Products Co., New York, N. Y.
Oxweld Acetylene Co., Chicago, Ill.

CYLINDERS.
National Tube Co., Pittsburgh, Pa.

DERRICKS.
American Bridge Co., New York, N. Y.
Dake Engine Co., Grand Haven, Mich.

DIES.
Jones & Lamson Mach. Co., Springfield, Mass.
Landis Machine Co., Waynesboro, Pa.
Long & Allstatter Co., Hamilton, O.
Modern Tool Co., Erie, Pa.
Toledo Machine & Tool Co., Toledo, O.

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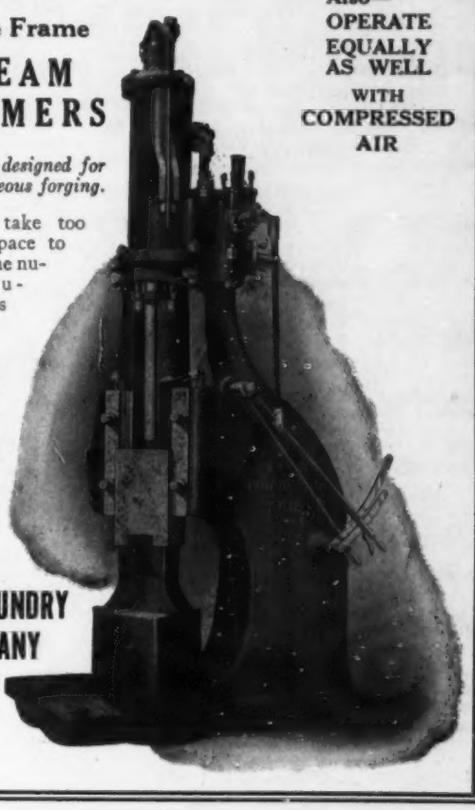

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DOCKS.
(Ore.)
American Bridge Co., New York, N. Y.

DOLOMITE.
(Double-dead, Burned Roasted.)
Davison, Allen S., Company, Pittsburgh, Pa.

DREDGES.
Thew Automatic Shovel Co., Lorain, O.

DRESSING.
(Belt.)
Dixon, Jos., Crucible Co., Jersey City, N. J.

DRILLS.
(Electric.)
Van Dorn & Dutton Co., Cleveland, O.

DRILLS.
(Multiple.)
Bäuth Machine Tool Co., Springfield, Mass.

DRILLS.
(Pneumatic.)
Allen, John F., Co., New York, N. Y.
Cleveland Pneumatic Tool Co., Cleveland, O.

DRILLS.
(Portable.)
Newton Mach. Tool Works, Inc., Philadelphia, Pa.

DRILLS.
(Twist.)
Morse Twist Drill & Machine Co., New Bedford, Mass.
Ryerson, Jos. T., & Son, Chicago, Ill.

DRIVERS.
(Pile.)
Industrial Works, Bay City, Mich.

DYNAMOS.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

EFFICIENCY DEVICES.
(Time Study Watches.)
Silberberg, M. J., Chicago, Ill.

ELECTRIC WELDERS.
Detroit Electric Welder Co., Detroit, Mich.

ELECTRICAL INSTRUMENTS.
(Repaired and Tested.)
Stupakoff Laboratories, Pittsburgh, Pa.

ELEVATORS.
Ridgway & Son, Craig, Coatesville, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

ENGINEERS AND CONTRACTORS.
Abramsen Engineering Co., Pittsburgh, Pa.
Alliance Structural Co., Alliance, O.
American Bridge Co., New York, N. Y.
Ayer & Lord Tie Co., Chicago, Ill.
Blair Engineering Co., Chicago, Ill.
Eichleay, John Jr., Co., Pittsburgh, Pa.
Groton Bridge Co., Groton, N. Y.
Hartman, W. E., Chicago, Ill.
Hunt, Robert W., & Co., Chicago, Ill.
Laughlin, Alex., & Co., Pittsburgh, Pa.
Lehigh Clutch Co., Camden, N. J.
McClintic-Marshall Co., Pittsburgh, Pa.
McClure, Geo. W., Son & Co., Pittsburgh, Pa.
McKee, Arthur G., & Co., Cleveland, O.
Mesta Machine Co., Pittsburgh, Pa.
Morgan Engineering Co., Alliance, O.
Searing & Coultas, Pittsburgh, Pa.
Smythe, The S. R., Co., Pittsburgh, Pa.
Swindell, Wm., & Bros., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Wellman-Seaver-Morgan Co., Cleveland, O.

ENGINEERS AND CONTRACTORS.
(By-Product Coke Ovens.)
Hartman, W. E., Chicago, Ill.

ENGINES.
(Blowing.)
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.

ENGINES.
(Corliss.)
Cooper, C. & G., Co., Mt. Vernon, O.
Mesta Machine Co., Pittsburgh, Pa.

ENGINES.
(Gas, Gasoline and Oil.)
Cooper, C. & G., Co., Mt. Vernon, O.
Mesta Machine Co., Pittsburgh, Pa.
National Transit Co., Oil City, Pa.
Tod Co., Wm., Youngstown, O.

ENGINES.
(Hoisting.)
Dake Engine Co., Grand Haven, Mich.
Mead-Morrison Mfg. Co., East Boston, Mass.
Vulcan Iron Works, Wilkesbarre, Pa.

ENGINES.
(Pneumatic.)
Detroit Hoist & Machine Co., Detroit, Mich.

ENGINES.
(Pumping.)
Tod Co., Wm., Youngstown, O.

ENGINES.
(Reversing.)
Mesta Machine Co., Pittsburgh, Pa.

ENGINES.
(Steam.)
Cooper, C. & G., Co., Mt. Vernon, O.
Dake Engine Co., Grand Haven, Mich.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Phoenix Iron Works Co., Meadville, Pa.
Tod Co., Wm., Youngstown, O.
Vulcan Iron Works, Wilkesbarre, Pa.

ENGRAVERS.
(Steel and Copper Plate.)
Wiggins Co., John B., Chicago, Ill.

EQUIPMENT.
(Lighting Plant.)
Crocker-Wheeler Co., Ampere, N. J.
Smith Gas Power Co., The, Lexington, O.

EQUIPMENT.
(Rolling Mill.)
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Mesta Machine Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

EQUIPMENT.
(Welded Chain, Wire and Wire Nail Mills—Complete.)
Morgan Construction Co., Worcester, Mass.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

EXTRACTORS.
(Tar.)
Smith Gas Power Co., The, Lexington, O.

EYEBARS.
American Bridge Co., New York, N. Y.

FACINGS.
(Foundry.)
Dixon, Jos., Crucible Co., Jersey City, N. J.

FENCE POSTS.
Ayer & Lord Tie Co., Chicago, Ill.

FENCING.
Cambria Steel Co., Philadelphia, Pa.
Youngstown Sheet & Tube Co., Youngstown, O.

FERRO-MANGANESE.
Blackwell, Geo. G., & Sons, Ltd., Liverpool, England.
Mohr, J. J., & Son, Philadelphia, Pa.
Pickands, Brown & Co., Chicago, Ill.
Rogers, Brown & Co., Cincinnati, O.
Samuel, Frank, Philadelphia, Pa.

FERRO-SILICON.
Blackwell, Geo. G., & Sons, Ltd., Liverpool, England
Davison, Allen S., Company, Pittsburgh, Pa.
Mohr, J. J., & Son, Philadelphia, Pa.
Pickands, Brown & Co., Chicago, Ill.
Rogers, Brown & Co., Cincinnati, O.
Samuel, Frank, Philadelphia, Pa.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.

FILES.
Barnett, G. & H., Co., Philadelphia, Pa.
Disston & Sons, Inc., Henry, Philadelphia, Pa.
Nicholson File Co., Providence, R. I.

FITTINGS.
(Pipe.)
Illinois Malleable Iron Co., Chicago, Ill.
Kennedy-Stroh Corp., Best Mfg. Dept., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.
Pittsburgh Piping & Equip. Co., Pittsburgh,
United Engrg. & Fdy. Co., Pittsburgh, Pa.

FLANGE PACKINGS.
(Leather.)
Graton & Knight Mfg. Co., The, Worcester, Mass.

FLANGES.
Dart, E. M., Mfg. Co., Providence, R. I.
National Tube Co., Pittsburgh, Pa.
Pittsburgh Piping & Equip. Co., Pittsburgh.

FLASKS.
Sterling Wheelbarrow Co., Milwaukee, Wis.

FLAT WIRE—FLAT COLD ROLLED STEEL.
American Steel & Wire Co., Chicago, Ill.

FLOORING.
(Bridge.)
Youngstown Iron & Steel Co., Youngstown, O.

FLOORING.
(Creosoted Wood.)
Ayer & Lord Tie Co., Chicago, Ill.
Pittsburgh Wood Preserving Co., Pittsburgh.

FLUOR-SPAR.
Rogers, Brown & Co., Cincinnati, O.

FLY WHEELS.
Mesta Machine Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.

FORGINGS.
American Bridge Co., New York, N. Y.
American Iron & Steel Mfg. Co., Lebanon, Pa.
Bethlehem Steel Co., South Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Champion Mch. & Forging Co., Cleveland, O.
Columbus Forge & Iron Co., Columbus, O.
Drop Forging Co. of N. Y., Jersey City, N. J.
Eccles, Richard, Co., Auburn, N. Y.
Ingalls-Shepard Forging Co., Chicago, Ill.
Kropp Forge Co., Chicago, Ill.
Leard, Wm. E., New Brighton, Pa.
Otis Steel Co., Cleveland, O.
Rockford Drop Forge Co., Rockford, Ill.

FORGINGS.
(Auto.)
General Drop Forge Co., Buffalo, N. Y.
Kropp Forge Co., Chicago, Ill.

FORGINGS.
(Car and Locomotive.)
American Iron & Steel Mfg. Co., Lebanon, Pa.
Cambria Steel Co., Philadelphia, Pa.
Oliver Iron & Steel Co., Pittsburgh, Pa.

FORGINGS.
(Copper and Alloy Steel.)
Kropp Forge Co., Chicago, Ill.

FORGINGS.
(Drop.)
Champion Mach. & Forging Co., Cleveland, O.
Columbus Forge & Iron Co., Columbus, O.
Drop Forging Co. of N. Y., Jersey City, N. J.
Eccles, Richard, Co., Auburn, N. Y.
General Drop Forge Co., Buffalo, N. Y.
Ingalls-Shepard Forging Co., Chicago, Ill.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Racine Drop Forge Co., Racine, Wis.
Rockford Drop Forge Co., Rockford, Ill.

FOUNDRY EQUIPMENT AND SUPPLIES.
(Iron and Brass.)
Arcade Mfg. Co., Freeport, Ill.
Pridmore, Henry E., Chicago, Ill.
Sterling Wheelbarrow Co., Milwaukee, Wis.
Whiting Foundry Equipment Co., Harvey, Ill.

FRICTION CLUTCH.
Lehigh Clutch Co., The, Camden, N. J.

FURNACE INSULATION.
Armstrong Cork Co., Pittsburgh, Pa.

FURNACES.
(Annealing.)
Hagan, Geo. J., Pittsburgh, Pa.
Quigley Furnace & Fdy. Co., New York, N. Y.
Swindell & Bros., Wm., Pittsburgh, Pa.
Whiting Fdy. Equipment Co., Harvey, Ill.

FURNACES.
(Billet and Plate Heating.)
Quigley Furnace & Fdy. Co., New York, N. Y.

FURNACES.
(Blast.)
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
McClure, Son & Co., G. W., Pittsburgh, Pa.
McKee, Arthur G., & Co., Cleveland, O.
Mt. Vernon Bridge Co., Mt. Vernon, O.
Muskegon Boiler Works, Muskegon, Mich.
Riter-Conley Mfg. Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
Wellman-Seaver-Morgan Co., Cleveland, O.

FURNACES.
(Crucible.)
Laughlin & Co., Alex., Pittsburgh, Pa.
Whiting Fdy. Equipment Co., Harvey, Ill.

FURNACES.
(Electric.)
Crowley Co., Jno. A., New York City.

FURNACES.
(Forging.)
Quigley Furnace & Foundry Co., New York, N. Y

FURNACES.
(Heat Testing.)
Quigley Furnace & Foundry Co., New York, N. Y.

FURNACES.
(Lead, Pot and Muffle Annealing, Wire Mills.)
Morgan Construction Co., Worcester, Mass.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

FURNACES.
(Melting.)
Whiting Foundry Equipment Co., Harvey, Ill.

FURNACES.
(Oil, Gas or Coke, Welding Chain Factories.)
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

FURNACES.
(Open-Hearth.)
Smythe Co., S. R., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

See Index to Advertisements for pages containing advertisements of companies listed above

FURNACES.
(Reheating.)
Morgan Construction Co., Worcester, Mass.

FURNACES.
(Shrapnel.)
Railway Materials Co., Chicago Ill.

FURRING.
(Metal.)
Youngstown Iron & Steel Co., Youngstown, O.

GAS PRODUCERS.
Koppers, H., Co., Pittsburgh, Pa.

GAS RECOVERY COKE OVENS.
Koppers, H., Co., Pittsburgh, Pa.

GASKETS.
(Leather.)
Graton & Knight Mfg. Co., The, Worcester, Mass.

GEAR CUTTING.
Bilgram Machine Works, Philadelphia, Pa.
Newton Mach. Tool Works, Philadelphia, Pa.
Tod, Co., Wm., Youngstown, O.

GEARS.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Dake Engine Co., Grand Haven, Mich.
Falk Co., The, Milwaukee, Wis.
Farrell Fdy. & Mch. Co., Ansonia, Conn.
Fawcus Machine Co., Pittsburgh, Pa.
Horsburgh & Scott Co., Cleveland, O.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Mesta Machine Co., Pittsburgh, Pa.
National Transit Co., Oil City, Pa.
New Process Gear Corpn., Syracuse, N. Y.
Nuttall, R. D., Co., Pittsburgh, Pa.
Taylor-Wharton Iron & Steel Co., Highbridge, N. J.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleveland, O.

GEARS.
(Bevel.)
Fawcus Machine Co., Pittsburgh, Pa.
Horsburgh & Scott Co., Cleveland, O.
New Process Gear Corpn., Syracuse, N. Y.
Nuttall, R. D., Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.

GEARS.
(Cast Steel, Machine Molded.)
American Steel Foundries, Chicago, Ill.
Horsburgh & Scott Co., Cleveland, O.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Mesta Machine Co., Pittsburgh, Pa.
Nuttall, R. D., Co., Pittsburgh, Pa.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

GEARS.
(Cut.)
Chicago Rawhide Mfg. Co., Chicago, Ill.
Fawcus Machine Co., Pittsburgh, Pa.
Horsburgh & Scott Co., Cleveland, O.
Mesta Machine Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
New Process Gear Corpn., Syracuse, N. Y.
Nuttall, R. D., Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
Van Dorn & Dutton Co., Cleveland, O.

GEARS.
(Double Helical Cut.)
Fawcus Machine Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.

GEARS.
(Rawhide.)
Chicago Rawhide Mfg. Co., Chicago, Ill.
Horsburgh & Scott Co., Cleveland, O.
New Process Gear Corpn., Syracuse, N. Y.
Nuttall, R. D., Co., Pittsburgh, Pa.

GENERATORS.
(Direct and Alternating.)
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

GENERATORS.
(Hydrogen.)
International Oxygen Co., New York, N. Y.

GENERATORS.
(Oxygen.)
International Oxygen Co., New York, N. Y.

GOGGLES.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

GRAPHITE.
Dixon, Jos., Crucible Co., Jersey City, N. J.

GRATES.
Green Engrg. Co., Chicago, Ill.

GRINDERS.
Modern Tool Co., Erie, Pa.

GRINDERS.
(Chain Die, Welded Chain Factories.)
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

GRINDERS.
(Crank Shaft.)
Modern Tool Co., Erie, Pa.

GRINDERS.
(Die.)
Modern Tool Co., Erie, Pa.

GRINDERS.
(Electrical Driven.)
Cincinnati Electrical Tool Co., Cincinnati, O.

GRINDERS.
(Nail Machines, Knife, Wire Nail Mills.)
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

GRINDERS.
(Ore.)
Chalmers & Williams, Chicago Heights, Ill.

GRINDERS.
(Pneumatic.)
Cleveland Pneumatic Tool Co., Cleveland, O.

GRINDERS.
(Universal.)
Modern Tool Co., Erie, Pa.

GRINDING MACHINERY.
(Cylindrical.)
Norton Grinding Co., Worcester, Mass.

GRINDING WHEEL STAND.
(Bench Type.)
Norton Grinding Co., Worcester, Mass.

GRINDING WHEEL STAND.
(Floor Type.)
Norton Grinding Co., Worcester, Mass.

HAMMERS.
(Belt-Driven.)
Beaudry & Co., Inc., Boston, Mass.

HAMMERS.
(Drop.)
Alliance Machine Co., Alliance, O.
Bliss, E. W., Co., Brooklyn, N. Y.
Buffalo Fdy. & Machine Co., Buffalo, N. Y.
Chambersburg Engrg. Co., Chambersburg, Pa.
Erie Foundry Co., Erie, Pa.
Niles-Bement-Pond Co., New York, N. Y.
Toledo Machine & Tool Co., Toledo, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

HAMMERS.
(Drop Forging.)
Buffalo Foundry & Mach. Co., Buffalo, N. Y.
Toledo Machine & Tool Co., Toledo, O.

HAMMERS.
(Foot and Power, Welded Chain Factories.)
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

HAMMERS.
(Pneumatic.)
Cleveland Pneumatic Tool Co., Cleveland, O.
Ryerson, Joseph T., & Son, Chicago, Ill.

HAMMERS.
(Pneumatic Forging.)
Barr, H. Edsil, Erie, Pa.

HAMMERS.
(Power.)
Beaudry & Co., Inc., Boston, Mass.
Buffalo Fdy. & Machine Co., Buffalo, N. Y.
Cleveland Punch & Shear Works Co., Cleveland, O.
Toledo Machine & Tool Co., Toledo, O.

HAMMERS.
(Rawhide.)
Chicago Rawhide Mfg. Co., Chicago, Ill.

HAMMERS.
(Steam.)
Buffalo Fdy. & Mach. Co., Buffalo, N. Y.
Chambersburg Engrg. Co., Chambersburg, Pa.
Erie Foundry Co., Erie, Pa.
Niles-Bement-Pond Co., New York, N. Y.

HAND LEATHERS.
Graton & Knight Mfg. Co., The, Worcester, Mass.

HANGERS.
New Departure Mfg. Co., Bristol, Conn.

HEADS.
(Dished.)
Worth Bros., Coatesville, Pa.

HEADS.
(Exhaust.)
Royal Ventilator Co., Philadelphia, Pa.

HEAT TREATING.
Racine Drop Forge Co., Racine, Wis.

HOISTS.
(Chain.)
Chisholm & Moore Mfg. Co., Cleveland, O.
Dake Engine Co., Grand Haven, Mich.

HOISTS.
(Compressed Air Geared.)
Dake Engine Co., Grand Haven, Mich.
Detroit Hoist & Machine Co., Detroit, Mich.
Whiting Fdy. Equipment Co., Harvey, Ill.

HOISTS.
(Electric.)
Alliance Machine Co., Alliance, O.
Browning Co., The, Cleveland, O.
Euclid Crane & Hoist Co., Euclid, O.
Morgan Engineering Co., Alliance, O.
Niles-Bement-Pond Co., New York, N. Y.
Northern Engineering Works, Detroit, Mich.
Toledo Bridge & Crane Co., Toledo, O.
Whiting Foundry Equipment Co., Harvey, Ill.

HOISTS.
(Pneumatic.)
Dake Engine Co., Grand Haven, Mich.
Detroit Hoist & Machine Co., Detroit, Mich.
Ridgway & Son, Craig, Coatesville, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

HOOPS AND BANDS.
Bourne-Fuller Co., The, Cleveland, O.
Carnegie Steel Co., Pittsburgh, Pa.
Illinois Steel Co., Chicago, Ill.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Ryerson, Joseph T., & Son, Chicago, Ill.
Scully Steel & Iron Co., Chicago, Ill.

HOOPS AND BANDS.
(Cold Rolled.)
Schwartz-Herrmann Steel Works, New York.

HOSE.
(Pneumatic.)
Cleveland Pneumatic Tool Co., Cleveland, O.

HYDRAULIC LEATHERS.
Graton & Knight Mfg. Co., The Worcester, Mass.
Williams, I. B., & Sons, Dover, N. H.

HYDROGEN.
International Oxygen Co., New York, N. Y.

INGOT MOLD.
(Vacuum Chamber.)
Hitt, S. E., Elyria, O.

INSTRUMENTS.
(Electrical.)
Beighlee Electric Co., Cleveland, O.

INSTRUMENTS.
(Electric Indicating and Recording.)
Beighlee Electric Co., Cleveland, O.
Brown Instrument Co., Philadelphia, Pa.
Smith Gas Power Co., The, Lexington, O.

INSULATING BRICK.
Armstrong Cork Co., Pittsburgh, Pa.

INSULATION.
(Furnaces, Boiler Settings, Steam Pipes, Etc.)
Armstrong Cork Company, Pittsburgh, Pa.

IRON.
(Basic—Bessemer—Malleable.)
Inland Steel Co., Chicago, Ill.
Pickands, Brown & Co., Chicago, Ill.

IRON.
(Cutting Apparatus.)
Newton Mach. Tool Works, Inc., Philadelphia, Pa.

IRON.
(Forging.)
Thomas Iron Co., Easton, Pa.

IRON.
(Foundry.)
Inland Steel Co., Chicago, Ill.
Thomas Iron Co., Easton, Pa.

IRON.
(Malleable.)
Thomas Iron Co., Easton, Pa.

IRON.
(Pig.)
Baird & West, Detroit, Mich.
Barnum-Richardson Co., Lime Rock, Conn.
Bourne-Fuller Co., The, Cleveland, O.
Carnegie Steel Co., Pittsburgh, Pa.
Columbus Iron & Steel Co., Columbus, O.
Domhoff & Joyce Co., The, Cincinnati, O.
Eaton, Rhodes & Co., Cincinnati, O.
Globe Iron Co., Jackson, O.
Hanna & Co., M. A., Cleveland, O.
Hillman & Sons Co., J. H., Pittsburgh, Pa.
Illinois Steel Co., Chicago, Ill.
La Belle Iron Works, Steubenville, O.
McKeefrey & Co., Leetonia, O.
Mitchell-Diggins Iron Co., Cadillac, Mich.
Mohr, J. J., & Son, Philadelphia, Pa.
Pickands, Brown & Co., Chicago, Ill.
Pickands, Mather & Co., Cleveland, O.
Republic Iron & Steel Co., Youngstown, O.
Rogers, Brown & Co., Cincinnati, O.
Samuel, Frank, Philadelphia, Pa.
Snyder & Co., W. P., Pittsburgh, Pa.
Stewart Iron Co., Ltd., Cleveland, O.
Superior Charcoal Iron Co., Grand Rapids, Mich.
Tenn. Coal Iron & R. R. Co., Birmingham, Ala.
Thomas Furnace Co., Milwaukee, Wis.
Thomas Iron Co., Easton, Pa.
Upson Nut Co., Cleveland, O.

IRON.
(Pig Malleable.)
Inland Steel Co., Chicago, Ill.

IRON.
(Staybolt.)
American Iron & Steel Mfg. Co., Lebanon, Pa.
Bourne-Fuller Co., The, Cleveland, O.

IRON AND STEEL.
(Galvanized.)
Bourne-Fuller Co., The, Cleveland, O.
McCalla, Harold, Philadelphia, Pa.
Ryerson, Jos. T., & Son, Chicago, Ill.
Whitaker-Glessner Co., Portsmouth Wks., Portsmouth, O.
Youngstown Sheet & Tube Co., Youngstown, O.

IRON AND STEEL.
(Norway and Swedish.)
Bourne-Fuller Co., The, Cleveland, O.
Scully Steel & Iron Co., Chicago, Ill.

See Index to Advertisements for pages containing advertisements of companies listed above

IRON AND STEEL.
(Scrap.)
American Bridge Co., New York, N. Y.

JACKS.
(Hydraulic.)
Watson-Stillman Co., New York, N. Y.

JOINTS.
(Rail.)
Carnegie Steel Co., Pittsburgh, Pa.
Lackawanna Steel Co., Buffalo, N. Y.

KEYS.
(Machine.)
Moltrup Steel Products Co., Beaver Falls, Pa.

KEYS AND COTTERS.
(Machine.)
Standard Gauge Steel Co., Beaver Falls, Pa.

KEYSEATERS.
Baker Bros., Toledo O.
Mitts & Merrill, Saginaw, Mich.

KILNS.
(Cement.)
Freeman, S., & Sons Mfg. Co., The, Racine, Wis.

KNIVES.
(Shear.)
White Co., L. & I. J., Buffalo, N. Y.

KNIVES.
(Solid Steel Shear.)
Tretheway & Co., Samuel, Pittsburgh, Pa.

LACE LEATHER.
Graton & Knight Mfg. Co., The, Worcester, Mass.
Williams, I. B., & Sons, Dover, N. H.

LADLES.
Riter-Conley Mfg. Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

LADLES.
(Blast Furnace.)
Freeman, S., & Sons Mfg. Co., The, Racine, Wis.

LAMPS.
(Arc.)
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

LAMPS.
(Incandescent.)
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

LATH.
(Expanded Metal.)
Youngstown Iron & Steel Co., Youngstown.

LATHES.
Cincinnati Iron & Steel Co., Cincinnati, O.
Jones & Lamson Mach. Co., Springfield, Vt.
Manning, Maxwell & Moore, Inc., New York, N. Y.
Niles-Bement-Pond Co., New York, N. Y.

LATHES.
(Roll.)
Mesta Machine Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
Niles-Bement-Pond Co., New York, N. Y.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Youngstown Fdy. & Mach. Co., Youngstown, O.

LATHES.
(Turret.)
Jones & Lamson Mach. Co., Springfield, Vt.
New Britain Mach. Co., New Britain, Conn.
Niles-Bement-Pond Co., New York, N. Y.

LEATHER BELTING.
(Steam and Waterproof.)
Graton & Knight Mfg. Co., The, Worcester, Mass.

LETTERHEADS.
(Engraved.)
Wiggins Co., John B., Chicago, Ill.

LINE MATERIAL.
(Telegraph and Telephone.)
National Tube Co., Pittsburgh, Pa.

LINING.
(Cupola.)
Louisville Fire Brick Works, Highland Park, Ky.

LINING.
(Forge and Furnace.)
Harbison-Walker Refractories Co., Pittsburgh.

LOCOMOTIVES.
Atlas Car & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Vulcan Iron Works, Wilkesbarre, Pa.

LOCOMOTIVES.
(Electric.)
Atlas Car & Mfg. Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LOCOMOTIVES.
(Industrial.)
Vulcan Iron Works, Wilkesbarre, Pa.

LUBRICANTS.
Dixon, Jos., Crucible Co., Jersey City, N. J.

LUMBER.
(Boxing, Crating, Flask and Pattern.)
Johnson Lumber Co., Milwaukee, Wis.

LUMBER.
(Creosoted.)
Ayer & Lord Tie Co., Chicago, Ill.

MACHINE KEYS.
Leard, Wm. E., New Brighton, Pa.

MACHINERY.
(Automatic Gear Cutting.)
Newton Mch. Tool Works, Inc., Philadelphia, Pa.

MACHINERY.
(Barb Wire Fence, Barb Nail Wire, Wire (Mills.)
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

MACHINERY.
(Bending and Straightening.)
Bertsch & Co., Cambridge City, Ind.
Birdsboro Steel Fdy. & Mach. Co., Birdsboro, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.
Espen-Lucas Machine Works, Philadelphia, Pa.
Long & Allstatter Co., Hamilton, O.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Niles-Bement-Pond Co., New York, N. Y.
United Engineering & Fdy. Co., Pittsburgh.
Watson-Stillman Co., New York, N. Y.

MACHINERY.
(Bolt and Nut.)
Landis Machine Co., Waynesboro, Pa.
National Machinery Co., Tiffin, O.
Newton Mach. Tool Works Inc., Philadelphia.
Williams Tool Co., Erie, Pa.

MACHINERY.
(Boring and Turning.)
Baker Bros., Toledo, O.
Cincinnati Planer Co., Cincinnati, O.
Espen-Lucas Machine Works, Philadephia, Pa.
Mitts & Merrill, Saginaw, Mich.
Newton Mach. Tool Wks., Inc., Philadelphia.
Niles-Bement-Pond Co., New York, N. Y.
Underwood, H. B., Company, Philadelphia, Pa.
Warner & Swasey Co., Cleveland, O.

MACHINERY.
(Cement.)
Johnson Engineering Works, Chicago, Ill.
Vulcan Iron Works, Wilkesbarre, Pa.

MACHINERY.
(Coal and Ash Handling.)
Orton & Steinbrenner Co., Chicago, Ill.

MACHINERY.
(Coil and Trace Chain, Welded Chain Factories.)
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

MACHINERY.
(Coping.)
Newton Mch. Tool Wks. Inc., Philadelphia.

MACHINERY.
(Crushing.)
Chalmers & Williams, Chicago Heights, Ill.
Johnson Engineering Works, Chicago, Ill.
Vulcan Iron Works, Wilkesbarre, Pa.

MACHINERY.
(Cutting Off—Cold Metal.)
Birdsboro Steel Fdy. & Mch. Co. Birdsboro, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.
Espen-Lucas Machine Works, Philadelphia, Pa.
Newton Mach. Tool Wks., Inc., Philadelphia.

MACHINERY.
(Drilling.)
Baush Machine Tool Co., Springfield, Mass.
National Machinery Co., The, Tiffin, O.
Newton Mach. Tool Wks., Inc., Philadelphia.
Niles-Bement-Pond Co., New York, N. Y.

MACHINERY.
(Drilling and Boring, Horizontal.)
Newton Mach. Tool Works, Inc., Philadelphia, Pa.

MACHINERY.
(Drilling, Multiple.)
Baush Machine Tool Co., Springfield, Mass.
Newton Mach. Tool Works, Inc. Philadelphia, Pa.
Niles-Bement-Pond Co., New York, N. Y.

MACHINERY.
(Drilling, Radial.)
Baush Machine Tool Co., Springfield, Mass.
Newton Mach. Tool Wks., Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York, N. Y.

MACHINERY.
(Electrical.)
Moore, Edgar M., & Co., Pittsburgh, Pa.

MACHINERY.
(Electric Welding.)
Thomson Electric Welding Co., Lynn, Mass.
Toledo Electric Welder Co., Toledo, O.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

MACHINERY.
(Elevating and Conveying.)
Brown Hoisting Machinery Co., Cleveland, O.
McMyler Interstate Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Vulcan Iron Works, Wilkesbarre, Pa.
Wellman-Seaver-Morgan Co., Cleveland, O.

MACHINERY.
(Forging.)
Bethlehem Steel Co., South Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Mesta Machine Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

MACHINERY.
(Galvanizing.)
Erie Foundry Co., Erie, Pa.

MACHINERY.
(Gear Cutting.)
Bilgram Machine Works, Philadelphia, Pa.
Newton Machine Tool Works, Inc., Philadelphia, Pa.

MACHINERY.
(Grinding.)
Blake & Johnson Co., Waterbury, Conn.
Johnson Engineering Works, Chicago, Ill.
Landis Tool Co., Waynesboro, Pa.
Newton Mch. Tool Works, Inc., Philadelphia, Pa.
Norton Grinding Co., Worcester, Mass.

MACHINERY.
(Hydraulic.)
Mesta Machine Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Watson-Stillman Co., New York, N. Y.

MACHINERY.
(Milling.)
Cincinnati Milling Mach. Co., Cincinnati, O.
Espen-Lucas Machine Works, Philadelphia, Pa.
Newton Mch. Tool Wks., Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York, N. Y.
Underwood, H. B., Company, Philadelphia, Pa.
Warner & Swasey Co., Cleveland, O.

MACHINERY.
(Mining.)
McMyler Interstate Co., Cleveland, O.
Thew Automatic Shovel Co., Lorain, O.

MACHINERY.
(Molding.)
Arcade Mfg. Co., Freeport, Ill.

MACHINERY.
(Natural Gas.)
Moore, Edgar M., & Co., Pittsburgh, Pa.

MACHINERY.
(Nut Facing.)
Newton Mch. Tool Wks., Inc.,

MACHINERY.
(Pipe Bending.)
Underwood, H. B., Company, Philadelphia, Pa.

MACHINERY.
(Pipe Mill.)
Landis Machine Co., Waynesboro, Pa.
Standard Engineering Co., Ellwood City, Pa.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Williams Tool Co., Erie, Pa.

MACHINERY.
(Planing.)
Newton Mch. Tool Wks., Inc., Philadelphia, Pa.

MACHINERY.
(Power Transmission.)
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Mesta Machine Co., Pittsburgh, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

MACHINERY.
(Pulverizing.)
Johnson Engineering Works, Chicago, Ill.

MACHINERY.
(Rolling Mill.)
Abramsen Engrg. Co., Pittsburgh, Pa.
Alliance Machine Co., Alliance, O.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Blake & Johnson Co., Waterbury, Conn.
Farrell Foundry & Mach. Co., Ansonia, Conn.
Fawcus Machine Co., Pittsburgh, Pa.
Garrison, A., Foundry Co., Pittsburgh, Pa.
Hilles & Jones, Wilmington, Del.
Hyde Park Fdy. & Mach. Co., Hyde Park, Pa.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Mesta Machine Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
Morgan Engineering Co., Alliance, O.
Newbold, R. S., & Son Co., Norristown, Pa.
Standard Engineering Co., Ellwood City, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Wellman-Seaver-Morgan Co., Cleveland, O.
Wheeling Mold & Fdy. Co., Pittsburgh, Pa.
Youngstown Fdy. & Mch. Co., Youngstown, O.

MACHINERY.
(Screw Making, Automatic.)
Cook Co., Asa S., Hartford, Conn.

MACHINERY.
(Second Hand.)
Baird Machy. Co., Pittsburgh, Pa.
Moore, Edgar M., & Co., Pittsburgh, Pa.
Niles-Bement-Pond Co., New York, N. Y.
Ryerson, Jos. T., & Son, Chicago, Ill.

See Index to Advertisements for pages containing advertisements of companies listed above

MACHINERY.
(Shearing.)
Erie Foundry Co., Erie, Pa.
Hilles & Jones, Wilmington, Del.
Mesta Machine Co., Pittsburgh, Pa.

MACHINERY.
(Sheet Metal Working.)
Bliss Co., E. W., Brooklyn, N. Y.

MACHINERY.
(Steam.)
Moore, Edgar M., & Co., Pittsburgh, Pa.

MACHINERY.
(Tapping.)
Baker Bros., Toledo, O.

MACHINERY.
(Thread Rolling.)
Blake & Johnson Co., Waterbury, Conn.

MACHINERY.
(Tin House.)
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

MACHINERY.
(Wire.)
Blake & Johnson Co., Waterbury, Conn.

MACHINERY.
(Wire Drawing, Wire and Rivet Works.)
Morgan Construction Co., Worcester, Mass.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

MACHINERY.
(Wire Galvanizing, Wire Tinning, Wire Nails.)
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

MACHINERY.
(Wire Nail.)
National Machinery Co., Tiffin, O.

MACHINERY.
(Wire Nails and Staples, Wire Nail Mills.)
Kilby Mfg. Co., Cleveland, O.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

MACHINISTS.
(Special Machinery.)
Bethlehem Steel Co., Scuth Bethlehem, Pa.
Blake & Johnson Co., Waterbury, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Dake Engine Co., Grand Haven, Mich.
Fawcus Machine Co., Pittsburgh, Pa.
Kilby Mfg. Co., Cleveland, O.
Long & Allstatter Co., Hamilton, O.
Manning, Maxwell & Moore, Inc., New York, N. Y.
Mesta Machine Co., Pittsburgh, Pa.
Morgan Engineering Co., Alliance, O.
Tod Co., Wm., Youngstown, O.
Toledo Machine & Tool Co., Toledo, O.
Torrington Mfg. Co., Torrington, Conn.

MAGNESITE.
Stowe-Fuller Co., The, Cleveland, O.

MAGNESITE.
(Dead Burned.)
American Refractories Co., Chicago, Ill.

MAGNETS.
(Electric Lifting.)
Electric Controller & Mfg. Co., Cleveland, O.

METALS.
(Antimony, Copper.)
Blackwell, Geo. G., Sons & Co., Liverpool, Eng.

METAL.
(Expanded.)
Youngstown Iron & Steel Co., Youngstown, O.

METAL.
(Heat Treatment Of.)
Steel Improvement Co., Cleveland, O.

METAL.
(Infusion Process For.)
Steel Improvement Co., Cleveland, O.

METAL.
(Non-Ferrous.)
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

METAL.
(Perforated.)
Erdle Perforating Co., Rochester, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.

METAL.
(Sheet.)
Erdle Perforating Co., Rochester, N. Y.

METAL.
(Washed.)
Brier Hill Steel Co., The, Youngstown, O.

METALLURGISTS.
Steel Improvement Co., Cleveland, O.

METERS.
(Blast Volume.)
Clark, Chas. J., Chicago, Ill.

MILL AND MINE SUPPLIES.
Dake Engine Co., Grand Haven, Mich.

MILLS.
(Billet.)
Morgan Construction Co., Worcester, Mass.

MILLS.
(Blooming, Universal, Plate, Sheet, Tin, Bar.)
Mesta Machine Co., Pittsburgh, Pa.

MILLS.
(Continuous Rolling.)
Morgan Construction Co., Worcester, Mass.

MILLS.
(Wire Complete Equipment.)
Blake & Johnson Co., Waterbury, Conn.
Morgan Construction Co., Worcester, Mass.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

MOLDING MACHINES.
Pridmore, Henry E., Chicago, Ill.

MOLDS.
(Ingot.)
Carnegie Steel Co., Pittsburgh, Pa.
Marshall Foundry Co., Pittsburgh, Pa.

MOTORS.
(Air.)
Dake Engine Co., Grand Haven, Mich.
Detroit Hoist & Machine Co., Detroit, Mich.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

MOTORS.
(Electric D. C. and A. C.)
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Moore, Edgar M., & Co., Pittsburgh, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS.
(Mill.)
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

NAILS.
Jones & Laughlin Steel Co., Pittsburgh, Pa.

NAILS.
(Steel Cut.)
La Belle Iron Works, Steubenville, O.

NAILS.
(Wire.)
Cambria Steel Co., Philadelphia, Pa.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, O.

NIPPLES.
National Tube Co., Pittsburgh, Pa.

NUTS.
American Bridge Co., New York, N. Y.
American Iron & Steel Co., Lebanon, Pa.
Bourne-Fuller Co., The, Cleveland, O.
Lockhart Iron & Steel Co., Pittsburgh, Pa.
Milton Mfg. Co., Milton, Pa.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scully Steel & Iron Co., Chicago, Ill.
Upson Nut Co., Cleveland, O.

NUTS.
(Hot Pressed.)
American Iron & Steel Mfg. Co., Lebanon, Pa.
Bourne-Fuller Co., The, Cleveland, O.
Milton Mfg. Co., Milton, Pa.
Republic Iron & Steel Co., Youngstown, O.
Upson Nut Co., Cleveland, O.

ORE.
(Chrome.)
Blackwell, Geo. G., Sons & Co., Ltd., Liverpool, Eng.
Samuel, Frank, Philadelphia, Pa.

ORE.
(Iron.)
Blackwell, Geo. G., Sons & Co., Ltd., Liverpool, Eng.
Breitung, E. N., & Co., Cleveland, O.
Hanna, M. A., & Co., Cleveland, O.
Hillman & Sons Co., J. H., Pittsburgh, Pa.
La Belle Iron Works, Steubenville, O.
Oglebay, Norton & Co., Cleveland, O.
Pickands, Brown & Co., Chicago, Ill.
Pickands, Mather & Co., Cleveland, O.
Snyder & Co., W. P., Pittsburgh, Pa.
Tod-Stambaugh Co., Cleveland, O.

OVENS.
(Coke and By-Product Recovery.)
Koppers, H., Co., Pittsburgh, Pa.

OVENS.
(Core.)
Quigley Furnace & Foundry Co., New York, N. Y.
Whiting Fdy. Equipment Co., Harvey, Ill.

OXYGEN.
International Oxygen Co., New York, N. Y.
Linde Air Products Co., New York City.

OXYGEN WELDING AND CUTTING APPARATUS.
International Oxygen Co., New York, N. Y.
Oxweld Acetylene Co., Chicago, Ill.

PACKINGS.
(Leather.)
Graton & Knight Mfg. Co., Worcester, Mass.

PAINT.
Dixon, Jos., Crucible Co., Jersey City, N. J.

PANELS.
(Current Limit, Protective.)
Electric Controller & Mfg. Co., Cleveland, O.

PANS.
(Grinding.)
Phillips & McLaren Co., Philadelphia, Pa.

PANS.
(Lathe.)
New Britain Machine Co., New Britain, Conn.

PANS.
(Shop.)
American Bridge Co., New York, N. Y.

PATTERNS.
Arcade Mfg. Co., Freeport, Ill.
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
Pridmore, Henry E., Chicago, Ill.

PERFORATING.
(Sheet Metal, Automatic, Screen Work.)
Erdle Perforating Co., Rochester, N. Y.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

PILING.
(Creosoted.)
Ayer & Lord Tie Co., Chicago, Ill.

PILING.
(Steel Sheet Interlocking.)
Carnegie Steel Co., Pittsburgh, Pa.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Lackawanna Steel Co., Buffalo, N. Y.

PINIONS.
Mesta Machine Co., Pittsburgh, Pa.
Nuttall, R. D., Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
Van Dorn & Dutton Co., Cleveland, O.

PINIONS.
(Mill Cut.)
Tod Co., Wm., Youngstown, O.

PINIONS.
(Rawhide.)
Chicago Rawhide Mfg. Co., Chicago, Ill.
Horsburgh & Scott Co., Cleveland, O.
New Process Gear Corpn., Syracuse, N. Y.
Nuttall, R. D., Co., Pittsburgh, Pa.

PINS.
(Knuckle and Brake.)
Champion Rivet Co., Cleveland, O.
Oliver Iron & Steel Co., Pittsburgh, Pa.

PIN.
(Pivot.)
Champion Rivet Co., Cleveland, O.

PIPE.
Bourne-Fuller Co., The, Cleveland, O.
Central Tube Co., Pittsburgh, Pa.
La Belle Iron Works, Steubenville, O.
National Tube Co., Pittsburgh, Pa.
Pittsburgh Piping & Equip. Co., Pittsburgh.
Republic Iron & Steel Co., Youngstown, O.
U. S. Cast Iron Pipe & Fdy. Co., Burlington, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE BENDING.
Kennedy-Stroh Corp., Best Mfg. Dept., Pittsburgh, Pa.

PIPE.
(Drive, Iron and Steel.)
National Tube Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE.
(Iron and Steel, Galvanized.)
National Tube Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE.
(Line, Iron and Steel.)
National Tube Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE.
(Riveted Steel.)
American Bridge Co., New York, N. Y.
Cambria Steel Co., Johnstown, Pa.
Muskegon Boiler Works, Muskegon, Mich.
Riter-Conley Mfg. Co., Pittsburgh, Pa.

PIPE.
(Wrought Iron.)
Bourne-Fuller Co., The, Cleveland, O.
Pittsburgh Piping & Equip. Co., Pittsburgh.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE COVERING.
Armstrong Cork Company, Pittsburgh, Pa.

PIPE LINE FITTINGS.
National Transit Co., Oil City, Pa.

PIPING.
(Power.)
Kennedy-Stroh Corp., Best Mfg. Dept., Pittsburgh, Pa.
Pittsburgh Piping & Equip. Co., Pittsburgh.

PLANERS.
Cincinnati Planer Co., Cincinnati, O.
Cleveland Punch & Shear Works Co., Cleveland, O.
Manning, Maxwell & Moore, Inc., New York, N. Y.
Niles-Bement-Pond Co., New York, N. Y.
Ryerson, Jos. T., & Son, Chicago, Ill.

PLANTS.
(Electric Lighting.)
Smith Gas Power Co., The, Lexington, O.

PLANTS.
(Powdered Coal.)
Quigley Furnace & Foundry Co., New York, N. Y.

See Index to Advertisements for pages containing advertisements of companies listed above

PLATES.
Allegheny Steel Co., Pittsburgh, Pa.
Bourne-Fuller Co., The, Cleveland, O.
Cambria Steel Co., Philadelphia, Pa.
Carbon Steel Co., Pittsburgh, Pa.
Carnahan Tin Plate & Sheet Co., Canton, O.
Illinois Steel Co., Chicago, Ill.
Illinois Steel Co., Warehouse Dept., Chicago, Ill.
Illinois Steel Warehouse Co., St. Louis, Mo.
Illinois Steel Warehouse Co., St. Paul, Minn.
La Belle Iron Works, Steubenville, O.
Lackawanna Steel Co., Buffalo, N. Y.
Otis Steel Co., Cleveland, O.
Republic Iron & Steel Co., Youngstown, O.
Ryerson, Jos. T., & Son, Chicago, Ill.
Taylor, N. & G., Co., Philadelphia, Pa.
Tenn. Coal, Iron & R. R. Co., Birmingham, Ala.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Wood, Alan, Iron & Steel Co., Philadelphia, Pa.
Worth Bros. Co., Coatesville, Pa.
Youngstown Sheet & Tube Co., Youngstown, O.

PLATES.
(Boiler and Tank.)
Bourne-Fuller Co., The, Cleveland, O.
Brown-Wales Co., Boston, Mass.
Inland Steel Co., Chicago, Ill.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
La Belle Iron Works, Steubenville, O.
Otis Steel Co., Cleveland, O.
Ryerson & Son, Jos. T., Chicago, Ill.

PLATES.
(Felloe.)
Wrought Washer Mfg. Co., Milwaukee, Wis.

PLATES.
(Floor, Rolled Steel.)
Carnegie Steel Co., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.
Wood, Alan, Iron & Steel Co., Philadelphia.

PLATES.
(Sheared.)
Bourne-Fuller Co., The, Cleveland, O.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Cincinnati Iron & Steel Co., Cincinnati, O.
Illinois Steel Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
La Belle Iron Works, Steubenville, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.

PLATES.
(Terne.)
American Sheet & Tin Plate Co., Pittsburgh, Pa.
Carnahan Tin Plate & Sheet Co., Canton, O.

PLATES.
(Tie.)
Illinois Steel Co., Chicago, Ill.
Lackawanna Steel Co., Buffalo, N. Y.

PLATES.
(Tin.)
American Sheet & Tin Plate Co., Pittsburgh, Pa.
Jones & Laughlin Steel Co., Pittsburgh, Pa.

PLATES.
(Universal.)
Bourne-Fuller Co., The, Cleveland, O.
Carnegie Steel Co., Pittsburgh, Pa.
Illinois Steel Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
La Belle Iron Works, Steubenville, O.
United Steel Co., Canton, O.
Youngstown Sheet & Tube Co., Youngstown, O.

PLATE WORK.
(Steel.)
Muskegon Boiler Works, Muskegon, Mich.

POINTERS.
(Wire Rod, Wire Mills.)
Morgan Construction Co., Worcester, Mass.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

POLES.
(Gin.)
American Bridge Co., New York, N. Y.

POTS.
(Galvanizing.)
American Bridge Co., New York, N. Y.

PRESSES.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Bliss, E. W., Co., Brooklyn, N. Y.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Mesta Machine Co., Pittsburgh, Pa.
Morgan Engineering Co., Alliance, O.
Niles-Bement-Pond Co., New York, N. Y.
Ryerson, Jos. T., & Son, Chicago, Ill.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Wood, R. D., & Co., Philadelphia, Pa.

PRESSES.
(Bending and Flanging.)
Chambersburg Engrg. Co., Chambersburg, Pa.
Mesta Machine Co., Pittsburgh, Pa.

PRESSES.
(Drill, Heavy Duty.)
Niles-Bement-Pond Co., New York, N. Y.

PRESSES.
(Drill, Multiple Spindle.)
Niles-Bement-Pond Co., New York, N. Y.

PRESSES.
(Forging.)
Chambersburg Engrg. Co., Chambersburg, Pa.
Mesta Machine Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Watson-Stillman Co., New York, N. Y.

PRESSES.
(Hydraulic.)
Chambersburg Engrg. Co., Chambersburg, Pa.
Mesta Machine Co., Pittsburgh, Pa.
Niles-Bement-Pond Co., New York, N. Y.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Watson-Stillman Co., New York, N. Y.

PRESSES.
(Power.)
Toledo Machine & Tool Co., Toledo, O.

PRESSES.
(Rail Straightening.)
Tod Co., Wm., Youngstown, O.

PRESSES.
(Steam, Sleeves, Runner Brick, Nozzle and Tuyeres, Fire Brick Works.)
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

PRESSES.
(Toggle Drawing.)
Toledo Machine & Tool Co., Toledo, O.

PRESSES.
(Trimming.)
Erie Foundry Co., Erie, Pa.
Toledo Machine & Tool Co., Toledo, O.

PRESSURE GAGES.
(Blast.)
Clark, Chas. J., Chicago, Ill.

PRINTERS.
(Plate.)
Wiggins Co., John B., Chicago, Ill.

PRODUCERS.
(Gas.)
Chapman Engineering Co., Mt. Vernon, O.
Hagan Co., Geo. J., Pittsburgh, Pa.
Koppers, H., Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
Smith Gas Power Co., The, Lexington, O.
Wellman-Seaver-Morgan Co., Cleveland, O.

PUMP LEATHERS.
Graton & Knight Mfg. Co., The, Worcester, Mass.

PUMPS.
Aldrich Pump Co., Allentown, Pa.
Deming Co., Salem, O.
National Transit Co., Oil City, Pa.
Southwark Fdy. & Mch. Co., Philadelphia, Pa.
Tod Co., Wm., Youngstown, O.

PUMPS.
(Boiler Feed.)
Aldrich Pump Co., Allentown, Pa.
Deming Co., Salem, O.
Vulcan Iron Works, Wilkesbarre, Pa.

PUMPS.
(Centrifugal.)
Dake Engine Co., Grand Haven, Mich.
Southwark Fdy. & Mch. Co., Philadelphia, Pa.

PUMPS.
(Deep Well.)
Deming Co., Salem, O.

PUMPS.
(Electric Driven.)
Aldrich Pump Co., Allentown, Pa.
Deming Co., Salem, O.

PUMPS.
(Elevator.)
Aldrich Pump Co., Allentown, Pa.

PUMPS.
(Hydraulic.)
Aldrich Pump Co., Allentown, Pa.
Chambersburg Engrg. Co., Chambersburg, Pa.
Deming Co., Salem, O.
Southwark Fdy. & Mch. Co., Philadelphia, Pa.

PUMPS.
(Mine.)
Aldrich Pump Co., Allentown, Pa.
Deming Co., Salem, O.

PUMPS.
(Vacuum.)
Buffalo Fdy. & Machine Co., Buffalo, N. Y.
Deming Co., Salem, O.
Mesta Machine Co., Pittsburgh, Pa.

PUNCHES AND SHEARS.
Allen, John F., Co., New York, N. Y.
Alliance Machine Co., Alliance, O.
Bertsch & Co., Cambridge City, Ind.
Birdsboro Steel Fdy. & Mach. Co., Birdsboro, Pa.
Bliss, E. W., Co., Brooklyn, N. Y.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones, Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Morgan Engineering Co., Alliance, O.
Niles-Bement-Pond Co., New York, N. Y.
Ryerson, Jos. T., & Son, Chicago, Ill.
Scully Steel & Iron Co., Chicago, Ill.
Standard Bridge Tool Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Watson-Stillman Co., New York, N. Y.
Wood, R. D., & Co., Philadelphia, Pa.

PUNCHES.
(Hand.)
Bourne-Fuller Co., The, Cleveland, O.

PUNCHES.
(Hydraulic.)
Mesta Machine Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
Watson-Stillman Co., New York, N. Y.

PUNCHES.
(Multiple.)
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones, Wilmington, Del.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.

PUNCHES.
(Pneumatic.)
Allen, John F., Co., New York, N. Y.

PUNCHES.
(Structural and Boiler Work.)
Richards Co. I. P., Providence, R. I.

PYROMETERS.
Beighlee Electric Co., Cleveland, O.
Brown Instrument Co., Philadelphia, Pa.
Stupakoff Laboratories, Pittsburgh, Pa.

RACKS.
(Steel or Tool.)
Angle Steel Stool Co., Otsego, Mich.
New Britain Mach. Co., New Britain, Conn.

RAILROAD SUPPLIES.
U. S. Metal & Mfg. Co., New York City.

RAILS.
Bourne-Fuller Co., The, Cleveland, O.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Illinois Steel Co., Chicago, Ill.
Illinois Steel Co., Warehouse Dept., Chicago, Ill.
Illinois Steel Warehouse Co., St. Louis, Mo.
Illinois Steel Warehouse Co., St. Paul, Minn.
Lackawanna Steel Co., Buffalo, N. Y.
Tenn. Coal, Iron & R. R. Co., Birmingham, Ala.

REAMERS.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

REELS.
(Wood and Iron, Wire Mills.)
Morgan Construction Co., Worcester, Mass.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

REGULATORS.
(Automatic Pressure.)
Electric Controller & Mfg. Co., Cleveland, O.

RELAYS.
(Field Rheostat.)
Electric Controller & Mfg. Co., Cleveland, O.

RESISTANCE.
(Cast Grid and Coil.)
Electric Controller & Mfg. Co., Cleveland, O.

RHEOSTATS.
(Motor Field, Motor Starting.)
Electric Controller & Mfg. Co., Cleveland, O.

RIM FRICTION CLUTCHES.
Lehigh Clutch Co., The, Camden, N. J.

RIVETS.
Falls Rivet Co., Kent, O.

RIVETS.
(Structural, Boiler, Ship and Tank.)
American Iron & Steel Mfg. Co., Lebanon, Pa.
Bourne-Fuller Co., The, Cleveland, O.
Champion Rivet Co., Cleveland, O.
Illinois Steel Co., Warehouse Dept., Chicago, Ill.
Illinois Steel Warehouse Co., St. Louis, Mo.
Illinois Steel Warehouse Co., St. Paul, Minn.
Inland Steel Co., Chicago, Ill.
Lockhart Iron & Steel Co., Pittsburgh, Pa.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Progressive Mfg. Co., Torrington, Conn.
Republic Iron & Steel Co., Youngstown, O.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Ryerson, Jos. T., & Son, Chicago, Ill.
Scully Steel & Iron Co., Chicago, Ill.
Upson Nut Co., Cleveland, O.

See Index to Advertisements for pages containing advertisements of companies listed above

RIVETS.
(Hydraulic.)
Chambersburg Engrg. Co., Chambersburg, Pa.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Niles-Bement-Pond Co., New York, N. Y.
Wood & Co., R. D., Philadelphia, Pa.

RIVETERS.
(Pneumatic.)
Allen, John F., Co., New York, N. Y.
Cleveland Pneumatic Tool Co., Cleveland, O.
Ryerson, Jos. T., & Son, Chicago, Ill.

RODS.
(Connecting.)
Leard, Wm. E., New Brighton, Pa.

RODS.
(Drill, Polished.)
Bourne-Fuller Co., The, Cleveland, O.

RODS.
(Iron and Steel.)
American Iron & Steel Mfg. Co., Lebanon, Pa.
Upson Nut Co., Cleveland, O.
Youngstown Sheet & Tube Co., Youngstown, O.

RODS.
(Rivet and Wire.)
Jones & Laughlin Steel Co., Pittsburgh, Pa.

RODS.
(Straightened and Cut.)
Youngstown Sheet & Tube Co., Youngstown, O.

ROLL GRINDING MACHINES.
Landis Tool Co., Waynesboro, Pa.
Norton Grinding Co., Worcester, Mass.

ROLLS.
(Bending and Straightening.)
Bertsch & Co., Cambridge City, Ind.
Hilles & Jones, Wilmington, Del.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

ROLLS.
(Sand Chilled and Steel.)
American Steel Foundries, Chicago, Ill.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Farrell Fdy. & Mach. Co., Ansonia, Conn.
Garrison, A., Foundry Co., Pittsburgh, Pa.
Hyde Park Fdy. & Mch. Co., Hyde Park, Pa.
Mesta Machine Co., Pittsburgh, Pa.
National Roll & Foundry Co., Avonmore, Pa.
Seaman, Sleeth & Co., Pittsburgh, Pa.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Youngstown Fdy. & Mach. Co., Youngstown, O.

ROOFING.
(Car, Metal, Galvanized, Plastic.)
American Sheet & Tin Plate Co., Pittsburgh, Pa.

ROOFING.
(Corrugated.)
American Sheet & Tin Plate Co., Pittsburgh.
Brier Hill Steel Co., Youngstown, O.
La Belle Iron Works, Steubenville, O.
Seneca Iron & Steel Co., Buffalo, N. Y.
Stark Rolling Mill Co., Canton, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Youngstown Sheet & Tube Co., Youngstown, O.

ROOFING.
(Iron and Steel.)
American Sh't & Tin Plate Co., Pittsburgh, Pa.
Massillon Rolling Mill Co., Massillon, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Western Reserve Steel Co., Warren, O.
Wood, Alan, Iron & Steel Co., Philadelphia.
Youngstown Iron & Steel Co., Youngstown, O.
Youngstown Sheet & Tube Co., Youngstown, O.

ROOFING TIMBER.
(Creosoted.)
Ayer & Lord Tie Co., Chicago, Ill.

RUNNING BALANCE INDICATING MACHINE.
Norton Grinding Co., Worcester, Mass.

RUNWAYS.
(Crane.)
American Bridge Co., New York, N. Y.

SAND.
(Molding.)
Gordon Sand Co., Inc., The, Conneaut, O.

SAND BLASTING.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

SAND BLAST.
(Chilled Shot for Use In.)
Globe Steel Co., Mansfield, O.

SAND BLAST ACCESSORIES.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

SAND BLAST EQUIPMENT.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

SAND BLAST TUMBLING BARRELS.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

SAWS.
(Band.)
Disston, Henry & Sons, Inc., Philadelphia, Pa.

SAWS.
(Cold Metal.)
Disston, Henry & Sons, Inc., Philadelphia, Pa.
Espen-Lucas Mch. Works, Philadelphia, Pa.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Newton Mach. Tool Wks., Inc., Philadelphia, Pa.

SAWS.
(Hack.)
Disston, Henry & Sons, Inc., Philadelphia, Pa.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Mesta Machine Co., Pittsburgh, Pa.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

SAWS.
(Milling.)
Disston, Henry & Sons, Inc., Philadelphia, Pa.

SCRAP IRON.
U. S. Metal & Mfg. Co., New York City.

SCREENS.
Hendrick Mfg. Co., Carbondale, Pa.

SCREENS.
(Pulsating.)
Chalmers & Williams, Chicago Heights, Ill.

SCREENS.
(Revolving.)
Chalmers & Williams, Chicago Heights, Ill.

SCREW STOCK.
(Free Cutting.)
Columbia Steel & Shafting Co., Pittsburgh, Pa.

SCREWS.
American Iron & Steel Mfg. Co., Lebanon, Pa.
Milton Mfg. Co., Milton, Pa.
Progressive Mfg. Co., Torrington, Conn.
Republic Iron & Steel Co., Youngstown, O.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

SEMI-UNIVERSAL GRINDING MACHINE.
Norton Grinding Co., Worcester, Mass.

SHAFTING.
Bourne-Fuller Co., The, Cleveland, O.
Cincinnati Iron & Steel Co., Cincinnati, O.
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Cumberland Steel Co., Cumberland, Md.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Scully Steel & Iron Co., Chicago, Ill.
Standard Gauge Steel Co., Beaver Falls, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.

SHAFTING.
(Cold Drawn or Rolled.)
Bourne-Fuller Co., The, Cleveland, O.
Republic Iron & Steel Co., Youngstown, O.

SHAFTING.
(Turned.)
Bourne-Fuller Co., The, Cleveland, O.

SHAPERS.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Manning, Maxwell & Moore, Inc., New York, N. Y.
Newton Mch. Tool Wks., Inc., Philadelphia.
Niles-Bement-Pond Co., New York, N. Y.

SHAPES.
(Agricultural.)
Carnegie Steel Co., Pittsburgh, Pa.
Laclede Steel Co., St. Louis, Mo.
Republic Iron & Steel Co., Youngstown, O.

SHAPES.
(Automobile.)
Moltrup Steel Products Co., Beaver Falls, Pa.

SHAPES.
(Steel, Structural and Special Rolled.)
Bourne-Fuller Co., The, Cleveland, O.
Cambria Steel Co., Philadelphia, Pa.
Illinois Steel Co., Chicago, Ill.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Moltrup Steel Products Co., Beaver Falls, Pa.
Scully Steel & Iron Co., Chicago, Ill.

SHAPES.
(Wire.)
Campbell Wire Specialty Works, South Bend, Ind.

SHEAR BLADES.
White Co., L. & I. J., Buffalo, N. Y.

SHEARS.
(Angle and Plate.)
Bertsch & Co., Cambridge City, Ind.
Hilles & Jones, Wilmington, Del.

SHEARS.
(Billet, Bloom and Slab.)
Garrison, A., Foundry Co., Pittsburgh, Pa.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

SHEARS.
(Doubling.)
Mesta Machine Co., Pittsburgh, Pa.

SHEARS.
(Flying and Bar.)
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.

SHEAR KNIVES.
White, L. & I. J. Co., Buffalo, N. Y.

SHEARS.
(Lever.)
Mesta Machine Co., Pittsburgh, Pa.
United Engrg. & Fdy. Co., Pittsburgh, Pa.
Watson-Stillman Co., New York, N. Y.
Youngstown Fdy. & Mch. Co., Youngstown.

SHEARS.
(Portable.)
Watson-Stillman Co., New York, N. Y.

SHEARS.
(Power.)
Toledo Machine & Tool Co., Toledo, O.

SHEARS.
(Scrap Alligator, Wire and Wire Nail Mills.)
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.
Youngstown Fdy. & Mch. Co., Youngstown.

SHEARS.
(Squaring.)
Bliss Co., E. W., Brooklyn, N. Y.
Erie Foundry Co., Erie, Pa.
Garrison, A., Foundry Co., Pittsburgh, Pa.
Mesta Machine Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

SHEARS.
(Vertical.)
Mesta Machine Co., Pittsburgh, Pa.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

SHEETS.
(Automobile.)
American Sheet & Tin Plate Co., Pittsburgh, Pa.

SHEETS.
(Black Steel.)
American Sheet & Tin Plate Co., Pittsburgh, Pa.
Bourne-Fuller Co., The, Cleveland, O.
Brier Hill Steel Co., Youngstown, O.
Canton Sheet Steel Co., Canton, O.
Cincinnati Iron & Steel Co., Cincinnati, O.
Inland Steel Co., Chicago, Ill.
La Belle Iron Works, Steubenville, O.
Ryerson, Joseph T., & Son, Chicago, Ill.
Seneca Iron & Steel Co., Buffalo, N. Y.
Stark Rolling Mill Co., Canton, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Youngstown Iron & Steel Co., Youngstown.
Youngstown Sheet & Tube Co., Youngstown.

SHEETS.
(Blue Annealed.)
American Sheet & Tin Plate Co., Pittsburgh.
Bourne-Fuller Co., The, Cleveland, O.
Cincinnati Iron & Steel Co., Cincinnati, O.
Inland Steel Co., Chicago, Ill.
La Belle Iron Works, Steubenville, O.
Seneca Iron & Steel Co., Buffalo, N. Y.
Stark Rolling Mill Co., Canton, O.
Western Reserve Steel Co., Warren, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Youngstown Sheet & Tube Co., Youngstown.

SHEETS.
(Corrugated.)
American Sheet & Tin Plate Co., Pittsburgh.
Bourne-Fuller Co., The, Cleveland, O.
Brier Hill Steel Co., Youngstown, O.
Canton Sheet Steel Co., Canton, O.
Cincinnati Iron & Steel Co., Cincinnati, O.
Inland Steel Co., Chicago, Ill.
La Belle Iron Works, Steubenville, O.
Ryerson, & Son, Joseph T., Chicago, Ill.
Seneca Iron & Steel Co., Buffalo, N. Y.
Stark Rolling Mill Co., Canton, O.
Trumbull Steel Co., Warren, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Youngstown Iron & Steel Co., Youngstown.
Youngstown Sheet & Tube Co., Youngstown.

SHEETS.
(Dead Soft for Stamping.)
American Sheet & Tin Plate Co., Pittsburgh.
Bourne-Fuller Co., The, Cleveland, O.
Canton Sheet Steel Co., Canton, O.
La Belle Iron Works, Steubenville, O.
Massillon Rolling Mill Co., Massillon, O.
Seneca Iron & Steel Co., Buffalo, N. Y.
Stark Rolling Mill Co., Canton, O.
Western Reserve Steel Co., Warren, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Youngstown Iron & Steel Co., Youngstown.
Youngstown Sheet & Tube Co., Youngstown.

SHEETS.
(Deep Drawing Stock.)
American Sheet & Tin Plate Co., Pittsburgh.
Bourne-Fuller Co., The, Cleveland, O.
La Belle Iron Works, Steubenville, O.
Massillon Rolling Mill Co., Massillon, O.
Youngstown Iron & Steel Co., Youngstown.

See Index to Advertisements for pages containing advertisements of companies listed above

SHEETS.
(Electric.)
American Sheet & Tin Plate Co., Pittsburgh, Pa.

SHEETS.
(Galvanized.)
Allegheny Steel Co., Pittsburgh, Pa.
American Sheet & Tin Plate Co., Pittsburgh.
Bourne-Fuller Co., The, Cleveland, O.
Brier Hill Steel Co., Youngstown, O.
Canton Sheet Steel Co., Canton, O.
Inland Steel Co., Chicago, Ill.
La Belle Iron Works, Steubenville, O.
Republic Iron & Steel Co., Youngstown, O.
Ryerson & Son, Jos. T., Chicago, Ill.
Seneca Iron & Steel Co., Buffalo, N. Y.
Stark Rolling Mill Co., Canton, O.
Trumbull Steel Co., Warren, O.
Western Reserve Steel Co., Warren, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Wood, Alan, Iron & Steel Co., Philadelphia.
Youngstown Iron & Steel Co., Youngstown, O.
Youngstown Sh't & Tube Co., Youngstown, O.

SHEETS.
(Iron and Steel.)
Allegheny Steel Co., Pittsburgh, Pa.
American Rolling Mill Co., Middletown, O.
American Sheet & Tin Plate Co., Pittsburgh.
Bourne-Fuller Co., The, Cleveland, O.
Canton Sheet Steel Co., Canton, O.
Disston & Sons Inc., Henry, Philadelphia, Pa.
Illinois Steel Co., Chicago, Ill.
Illinois Steel Co., Warehouse Dept., Chicago, Ill.
Illinois Steel Warehouse Co., St. Louis, Mo.
Illinois Steel Warehouse Co., St. Paul, Minn.
Massillon Rolling Mill Co., Massillon, O.
Republic Iron & Steel Co., Youngstown, O.
Ryerson, Jos. T., & Son, Chicago, Ill.
Scully Steel & Iron Co., Chicago, Ill.
Seneca Iron & Steel Co., Buffalo, N. Y.
Stark Rolling Mill Co., Canton, O.
Tenn. Coal, Iron & R. R. Co., Birmingham, Ala.
Trumbull Steel Co., Warren, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Wood, Alan, Iron & Steel Co., Philadelphia, Pa.
Worth Bros. Co., Coatesville, Pa.
Youngstown Sheet & Tube Co., Youngstown.

SHEETS.
(Open-Hearth.)
Bourne-Fuller Co., The, Cleveland, O.
Canton Sheet Steel Co., Canton, O.
La Belle Iron Works, Steubenville, O.
Seneca Iron & Steel Co., Buffalo, N. Y.
Stark Rolling Mill Co., Canton, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Youngstown Iron & Steel Co., Youngstown.

SHEETS.
(Pickled and Cold Rolled.)
Bourne-Fuller Co., The, Cleveland, O.
Canton Sheet Steel Co., Canton, O.
Massillon Rolling Mill Co., Massillon, O.
Western Reserve Steel Co., Warren, O.
Youngstown Sheet & Tube Co., Youngstown.

SHEETS.
(Polished.)
Bourne-Fuller Co., The, Cleveland, O.
Canton Sheet Steel Co., Canton, O.
Carnahan Tin Plate & Sheet Co., Canton, O.
Massillon Rolling Mill Co., Massillon, O.

SHEETS.
(Roofing.)
Canton Sheet Steel Co., Canton, O.
La Belle Iron Works, Steubenville, O.

SHEETS.
(Steel Box Annealed.)
Canton Sheet Steel Co., Canton, O.
La Belle Iron Works, Steubenville, O.
Western Reserve Steel Co., Warren, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Youngstown Iron & Steel Co., Youngstown.
Youngstown Sheet & Tube Co., Youngstown.

SHEET IRON WORK.
Hendrick Mfg. Co., Carbondale, Pa.

SHELVING.
(Steel.)
New Britain Mach. Co., New Britain, Conn.

SHOVELS.
(Steam.)
Thew Automatic Shovel Co., Lorain, O.

SHRAPNEL FURNACES.
Railway Materials Co., Chicago, Ill.

SIDING.
(Iron and Steel.)
American Sheet & Tin Plate Co., Pittsburgh, Pa.

SIFTERS.
(Sand.)
Arcade Mfg. Co., Freeport, Ill.
Whiting Fdy. Equipment Co., Harvey, Ill.

SLABS.
Cambria Steel Co., Philadelphia, Pa.
La Belle Iron Works, Steubenville, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Youngstown Sheet & Tube Co., Youngstown, O.

SLABS.
(Sheet.)
La Belle Iron Works, Steubenville, O.
Lackawanna Steel Co., Buffalo, N. Y.
Tenn. Coal, Iron & R. R. Co., Birmingham, Ala.
Youngstown Sh't & Tube Co., Youngstown, O.

SLEEPERS.
(Creosoted.)
Ayer & Lord Tie Co., Chicago, Ill.

SOLENOIDS.
(Electric.)
Electric Controller & Mfg. Co., Cleveland, O.

SPECIALTIES.
(Metal.)
White Co., L. & I. J., Buffalo, N. Y.

SPECIALTIES.
(Steam.)
National Tube Co., Pittsburgh, Pa.

SPIEGELEISEN.
Pickands, Brown & Co., Chicago, Ill.

SPIKES.
American Iron & Steel Mfg. Co., Lebanon, Pa.
American Steel & Wire Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
Republic Iron & Steel Co., Youngstown, O.

SPIKES.
(Dock and Railroad.)
Jones & Laughlin Steel Co., Pittsburgh, Pa.

SPIKES.
(Screw.)
American Iron & Steel Mfg. Co., Lebanon, Pa.
Illinois Steel Co., Chicago, Ill.

SPLICES.
(Rail.)
Carnegie Steel Co., Pittsburgh, Pa.
Lackawanna Steel Co., Buffalo, N. Y.
Republic Iron & Steel Co., Youngstown, O.

SPRINGS.
Duer Spring & Mfg. Co., Pittsburgh, Pa.

SPRINGS.
(Automobile.)
Duer Spring & Mfg. Co., Pittsburgh, Pa.

SPRINGS.
(Wire.)
Schwartz-Herrmann Steel Works, New York.

STACKS.
(Steel.)
American Bridge Co., New York, N. Y.
Freeman, S., & Sons Mfg. Co., The, Racine, Wis.
Muskegon Boiler Works, Muskegon, Mich.

STAMPINGS.
(Sheet Metal.)
Bettcher Mfg. Co., Cleveland, O.
Erdle Perforating Co., Rochester, N. Y.

STAMPINGS.
(Sheet Steel.)
New Britain Mch. Co., New Britain, Conn.

STARTERS.
(Electric Motor.)
Crocker-Wheeler Co., Ampere, N. J.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

STARTERS.
(Electric Motor.) (Manual, Automatic.)
Electric Controller & Mfg. Co., Cleveland, O.

STEEL.
American Bridge Co., New York, N. Y.
Bourne-Fuller Co., The, Cleveland, O.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Disston & Sons, Inc., Henry, Philadelphia, Pa.
Franklin Steel Works, Franklin, Pa.
Illinois Steel Co., Chicago, Ill.
Illinois Steel Co., Warehouse Dept., Chicago, Ill.
Illinois Steel Warehouse Co., St. Louis, Mo.
Illinois Steel Warehouse Co., St. Paul, Minn.
La Belle Iron Works, Steubenville, O.
Otis Steel Co., Cleveland, O.
Republic Iron & Steel Co., Youngstown, O.
Ryerson, Jos. T., & Son, Chicago, Ill.
Tenn. Coal, Iron & R. R. Co., Birmingham, Ala.
Upson Nut Co., Cleveland, O.
West Leechburg Steel Co., Pittsburgh, Pa.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.
Wood, Alan, Iron & Steel Co., Philadelphia, Pa.
Youngstown Sh't & Tube Co., Youngstown, O.

STEEL.
(Automobile.)
Carbon Steel Co., Pittsburgh, Pa.
United Steel Co., Canton, O.

STEEL.
(Axle, Automobile, Mining Car.)
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
United Steel Co., Canton, O.

STEEL.
(Chrome Nickel.)
Crowley Co., Jno. A., New York City.

STEEL.
(Chrome Vanadium.)
Crowley Co., Jno. A., New York City.

STEEL.
(Cold Rolled.)
Bourne-Fuller Co., The, Cleveland, O.
Pittsburgh Cold Rolled Steel Co., Pittsburgh, Pa.
Schwartz-Herrmann Steel Works, New York.
Scully Steel & Iron Co., Chicago, Ill.

STEEL.
(Cold Drawn.)
Bourne-Fuller Co., The, Cleveland, O.
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Moltrup Steel Products Co., Beaver Falls, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
United Steel Co., Canton, O.

STEEL.
(Drawing and Stamping.)
Schwartz-Herrmann Steel Works, New York.

STEEL.
(Electric.)
Crowley Co., Jno. A., New York City.
Illinois Steel Co., Chicago, Ill.

STEEL.
(Forging.)
United Steel Co., Canton, O.

STEEL.
(Gear.)
United Steel Co., Canton, O.

STEEL.
(High Speed.)
Bethlehem Steel Co., South Bethlehem, Pa.
Bourne-Fuller Co., The, Cleveland, O.
Firth-Sterling Steel Co., McKeesport, Pa.

STEEL.
(Nickel.)
United Steel Co., Canton, O.

STEEL.
(Open-Hearth.)
Bourne-Fuller Co., The, Cleveland, O.
Cambria Steel Co., Philadelphia, Pa.
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Illinois Steel Co., Chicago, Ill.
La Belle Iron Works, Steubenville, O.
Inland Steel Co., Chicago, Ill.
Union Drawn Steel Co., Beaver Falls, Pa.
Upson Nut Co., Cleveland, O.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.

STEEL.
(Rock Drill.)
Firth-Sterling Steel Co., McKeesport, Pa.

STEEL.
(Spring.)
Firth-Sterling Steel Co., McKeesport, Pa.
Schwartz-Herrmann Steel Works, New York.
United Steel Co., Canton, O.

STEEL.
(Structural.)
Alliance Structural Co., Alliance, O.
American Bridge Co., New York, N. Y.
Bellefontaine Bridge & Steel Co., The, Bellefontaine, O.
Bethlehem Steel Co., South Bethlehem, Pa.
Bourne-Fuller Co., The, Cleveland, O.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Cincinnati Iron & Steel Co., Cincinnati, O.
Eichleay, John Jr., Co., Pittsburgh, Pa.
Groton Bridge Co., Groton, N. Y.
Illinois Steel Co., Chicago, Ill.
Illinois Steel Co., Warehouse Dept., Chicago, Ill.
Illinois Steel Warehouse Co., St. Louis, Mo.
Illinois Steel Warehouse Co., St. Paul, Minn.
Inland Steel Co., Chicago, Ill.
Lackawanna Steel Co., Buffalo, N. Y.
McClintic-Marshall Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Riter-Conley Mfg. Co., Pittsburgh, Pa.
Ryerson, Joseph T., & Son, Chicago, Ill.
Whitaker-Glessner Co., Portsmouth Works, Portsmouth, O.

STEEL.
(Tool.)
Bethlehem Steel Co., South Bethlehem, Pa.
Bourne-Fuller Co., The, Cleveland, O.
Cincinnati Iron & Steel Co., Cincinnati, O.
Firth-Sterling Steel Co., McKeesport, Pa.
Ryerson, Joseph T., & Son, Chicago, Ill.

STEEL.
(Twisted.)
Bourne-Fuller Co., The, Cleveland, O.
Cincinnati Iron & Steel Co., Cincinnati, O.
Franklin Steel Works, Franklin, Pa.
Upson Nut Co., Cleveland, O.

STEEL.
(Vanadium.)
Bourne-Fuller Co., The, Cleveland, O.
Carnegie Steel Co., Pittsburgh, Pa.
United Steel Co., Canton, O.

STEEL STRIPS.
Schwartz-Herrmann Steel Works, New York.

STOKERS.
Erie Foundry Co., Erie, Pa.
Green Engineering Co., Chicago, Ill.

STOOLS.
(Steel.)
Angle Steel Stool Co., Otsego, Mich.

STOP WATCHES.
(Time Study.)
Silberberg, M. J., Chicago, Ill.

STOPS.
(Electric Limit.)
(For Cranes, etc.)
Electric Controller & Mfg. Co., Cleveland, O.

STRAP JOINTS.
Leard, Wm. E., New Brighton, Pa.

STRAIGHTENERS.
(Bar.)
Abramsen Engineering Co., Pittsburgh, Pa.

STRUCTURAL TIMBERS.
(Creosoted.)
Ayer & Lord Tie Co., Chicago, Ill.

See Index to Advertisements for pages containing advertisements of companies listed above

STUDDING.
(Metal.)
Youngstown Iron & Steel Co., Youngstown, O.

SUPPLIES.
(Well.)
National Tube Co., Pittsburgh, Pa.

SURFACE GRINDING MACHINE.
Norton Grinding Co., Worcester, Mass.

SWITCH BOARDS.
(For Cranes.)
Electric Controller & Mfg. Co., Cleveland, O.

SWITCHES.
(Automatic Float, Knife, Snap.)
Electric Controller & Mfg. Co., Cleveland, O.

SWITCHES.
(Electrical.)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SWITCHES.
(Magnetic.)
Electric Controller & Mfg. Co., Cleveland, O.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TABLES.
(Drawing.)
Economy Drawing Table Co., Toledo, O.

TABLES.
(Rolling Mill.)
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
Tod Co., Wm., Youngstown, O.
United Engrg. & Fdy. Co., Pittsburgh, Pa.

TABLES.
(Transfer.)
Industrial Works, Bay City, Mich.

TANKS AND TOWERS.
American Bridge Co., New York, N. Y.
Freeman, S., & Sons, Mfg. Co., The, Racine, Wis.
National Tube Co., Pittsburgh Pa.
Riter-Conley Mfg. Co., Pittsburgh, Pa.

TANKS.
(Acid and Chemical.)
Hauser-Stander Tank Co., The, Cincinnati, O.

TANKS.
(Water and Acid Storage, Wire Mills.)
Morgan Construction Co., Worcester, Mass.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

TANKS.
(Wooden.)
Hauser- Stander Tank Co., The, Cincinnati, O.

TEETH.
(Tempered Flats.)
Schwartz-Herrmann Steel Works, New York.

THERMOMETERS.
Brown Instrument Co., Philadelphia, Pa.

TIES.
(Creosoted.)
Ayer & Lord Tie Co., Chicago, Ill.

TILE.
(Fire Clay, Furnace, Hollow, Etc.)
Union Mining Co., Mt. Savage, Md.

TIN.
(Roofing.)
American Sheet & Tin Plate Co., Pittsburgh, Pa.

TIN PLATE.
American Sheet & Tin Plate Co., Pittsburgh, Pa.
Carnahan Tin Plate & Sheet Co., Canton, O.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Standard Tin Plate Co., Canonsburg, Pa.
Trumbull Steel Co., The, Warren, O.

TITANIUM.
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

TOOLS.
(Boring.)
Allen & Curtis Co., Mishawaka, Ind.

TOOLS.
(Edge.)
White Co., L. & I. J., Buffalo, N. Y.

TOOLS.
(Machinists.)
Morse Twist Drill & Mach. Co., New Bedford, Mass.

TOOLS.
(Pneumatic.)
Cleveland Pneumatic Tool Co., Cleveland, O.
Ryerson, Jos. T., & Son, Chicago, Ill.

TOOLS.
(Portable.)
Underwood, H. B., Co., Philadelphia, Pa.

TOOLS.
(Thread Cutting.)
Landis Machine Co., Waynesboro, Pa.

TRACK.
(Industrial.)
Atlas Car & Mfg. Co., Cleveland, O.
Chase Foundry & Mfg. Co., Columbus, O.

TRAMRAILS.
(Overhead Systems.)
Brown Hoisting Machinery Co., Cleveland, O.
Northern Engrg. Works, Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

TRAMWAYS.
American Steel & Wire Co., Chicago, Ill.

TRANSMISSION EQUIPMENT.
(Power.)
Jones & Laughlin Steel Co., Pittsburgh, Pa.

TRAPS.
(Steam.)
National Tube Co., Pittsburgh, Pa.

TROLLEYS.
Browning Co., Cleveland, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.

TRUCKS.
(Foundry.)
Sterling Wheelbarrow Co., Milwaukee, Wis.
Whiting Foundry Equipment Co., Harvey, Ill.

TRUCKS.
(Motors.)
Kissel Motor Car Co., Hartford, Wis.

TRUCKS.
(Wire, Rod, Wire Mills.)
Morgan Construction Co., Worcester, Mass.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

TUBES.
National Tube Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Youngstown Sh't & Tube Co., Youngstown, O.

TUBES.
(Boiler.)
Allegheny Steel Co., Pittsburgh, Pa.
Bourne-Fuller Co., The, Cleveland, O.
National Tube Co., Pittsburgh, Pa.
Ryerson, Joseph T., & Son, Chicago, Ill.
Scully Steel & Iron Co., Chicago, Ill.
Worth Bros Co., Coatesville, Pa.

TUBING.
(Automobile.)
National Tube Co., Pittsburgh, Pa.

TUBING.
(Oil Well.)
La Belle Iron Works, Steubenville, O.
National Tube Co., Pittsburgh, Pa.
Youngstown Sh't & Tube Co., Youngstown, O.

TUBING.
(Seamless Steel.)
National Tube Co., Pittsburgh, Pa.

TUMBLING MILLS.
Whiting Fdy. Equipment Co., Harvey, Ill.

TURBINES.
(Steam.)
General Electric Co., Schenectady, N. Y.
Southwark Fdy. & Mch. Co., Philadelphia, Pa.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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American Bridge Co., New York, N. Y.
American Iron & Steel Mfg. Co., Lebanon, Pa.
Bourne-Fuller Co., The, Cleveland, O.
Michigan Bolt & Nut Works, Detroit, Mich.
Milton Mfg. Co., Milton, Pa.
Republic Iron & Steel Co., Youngstown, O.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

TURNTABLES.
American Bridge Co., New York, N. Y.
Atlas Car & Mfg. Co., Cleveland, O.
Chase Foundry & Mfg. Co., Columbus, O.
Whiting Foundry Equipment Co., Harvey, Ill.

UNDER FLOORING.
(Creosoted.)
Ayer & Lord Tie Co., Chicago, Ill.

UNIONS.
(Pipe.)
Dart, E. M., Mfg. Co., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Kennedy-Stroh Corp., Best Mfg. Dept., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.

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Norton Grinding Co., Worcester, Mass.

VALVE LEATHERS.
Graton & Knight Mfg. Co., Worcester, Mass.

VALVES.
Kennedy-Stroh Corp., Best Mfg. Dept., Pittsburgh, Pa.
Mackintosh, Hemphill & Co., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.
Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.
Scully Steel & Iron Co., Chicago, Ill.

VALVES.
(Gas and Air Reversing.)
Morgan Construction Co., Worcester, Mass.

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(Hydraulic.)
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Mackintosh, Hemphill & Co., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.
Pittsburgh Piping & Equip. Co., Pittsburgh.
Watson-Stillman Co., New York, N. Y.

VATS.
(Acid and Chemical.)
Hauser- Stander Tank Co., The, Cincinnati, O.

VENTILATORS.
Royal Ventilator Co., Philadelphia, Pa.

WAGON HARDWARE.
Oliver Iron & Steel Co., Pittsburgh, Pa.

WASHERS.
American Iron & Steel Mfg. Co., Lebanon, Pa.
Bettcher Mfg. Co., Cleveland, O.
Bourne-Fuller Co., The, Cleveland, O.
Milton Mfg. Co., Milton, Pa.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Upson Nut Co., Cleveland, O.
Wrought Washer Mfg. Co., Milwaukee, Wis.

WASHERS.
(Leather.)
Graton & Knight Mfg. Co., The, Worcester, Mass.

WELDERS.
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Detroit Electric Welder Co., Detroit, Mich.
Long & Allstatter Co., Hamilton, O.
Thomson Elec. Welding Co., Lynn, Mass.
Toledo Electric Welder Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

WELDING.
(Custom.)
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Racine Drop Forge Co., Racine, Wis.
Thomson Electric Welding Co., Lynn, Mass.

WELDING.
(Oxy-Acetylene Process.)
Linde Air Products Co., New York, N. Y.
Oxweld Acetylene Co., Chicago, Ill.

WHEELBARROWS.
Sterling Wheelbarrow Co., Milwaukee, Wis.

WHEELS.
(Rope.)
Cooper, C. & G., Co., Mt. Vernon, O.
Mesta Machine Co., Pittsburgh, Pa.

WHEELS.
(Steel Car.)
American Steel Foundries, Chicago, Ill.
Carnegie Steel Co., Pittsburgh, Pa.

WIRE.
Cambria Steel Co., Philadelphia, Pa.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Youngstown Sh't & Tube Co., Youngstown, O.

WIRE.
(Barbed.)
Youngstown Sh't & Tube Co., Youngstown, O.

WIRE.
(Enameled Magnet.)
American Steel & Wire Co., Chicago, Ill.

WIRE.
(Telephone and Telegraph.)
American Steel & Wire Co., Chicago, Ill.

WIRE.
(Threaded.)
Progressive Mfg. Co., Torrington, Conn.

WIRE MILLS.
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Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

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American Steel & Wire Co., Chicago, Ill.

WIRE ROPE FITTINGS.
American Steel & Wire Co., Chicago, Ill.

WIRE WORK.
(Automatic.)
Campbell Wire Specialty Works, South Bend, Ind.

WOOD BLOCKS.
(Creosoted.)
Ayer & Lord Tie Co., Chicago, Ill.

WOODEN TANKS.
Hauser- Stander Tank Co., The, Cincinnati, O.

WRENCHES.
Ryerson, Jos. T., & Son, Chicago, Ill.

WRENCHES.
(Chain.)
Drop Forg'g Co. of N. Y., Jersey City, N. J.

WRENCHES.
(Pipe.)
Drop Forg'g Co. of N. Y., Jersey City, N. J.

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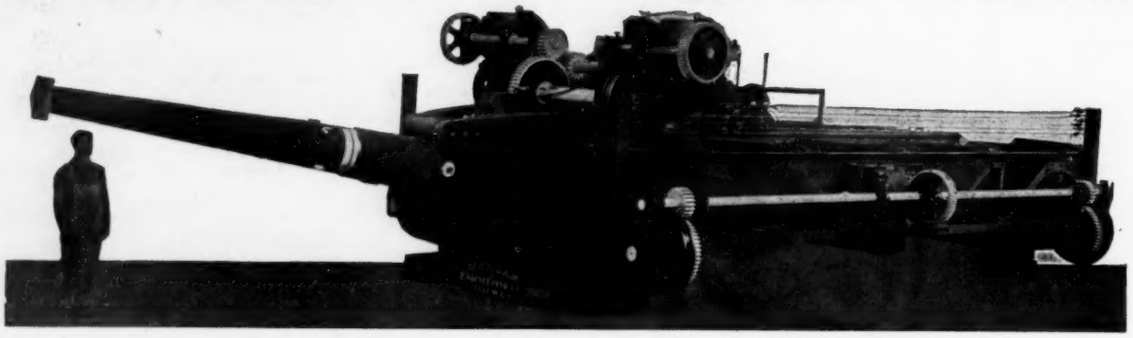

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PNEUMATIC GEARED **HOISTS** 1 to 15 Tons

MOTORS 2 TO 20 H.P. FOR Cranes Derricks Winches

Detroit Hoist & Machine Co.
DETROIT, MICH.

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THE BROWNING COMPANY, CLEVELAND
SALES OFFICES: NEW YORK, CHICAGO, PHILADELPHIA, SAN FRANCISCO

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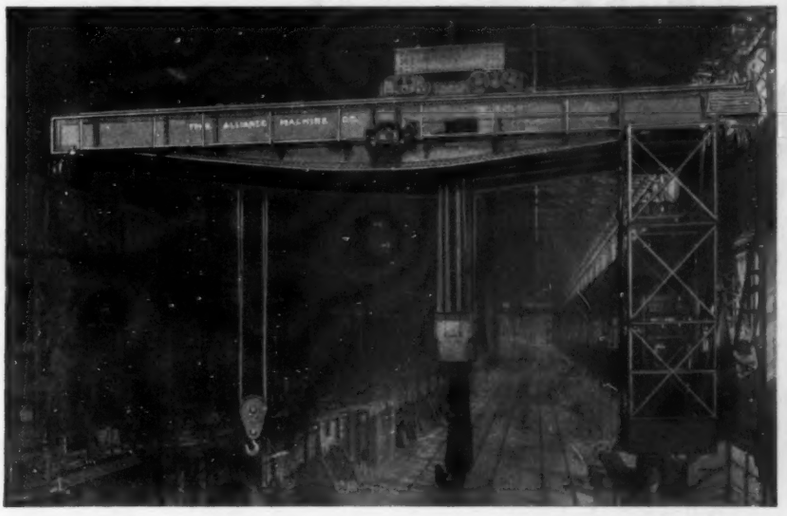
Electric and Hand Traveling Cranes. Electric and Air Hoists and Trollies.
NORTHERN ENGINEERING WORKS, DETROIT, MICH. (Canadian Works: Northern Crane Works, Ltd., Walkerville, Ont.)

"ALLIANCE" FOUR GIRDER LADLE CRANE

Three 175-ton
Twelve 150-ton
Twenty 125-ton
Thirteen 100-ton
Six 80-ton



Thirty-two 75-ton
Four 60-ton
Five 50-ton
Six 45-ton
Seven 40-ton
Four 30-ton

The cut shows one of the three 150-ton Ladle Cranes installed in the works of a large steel company. This crane represents the very latest construction for ladle cranes (we have built 112 of this type), and has seven distinct and important advantages over the old type of crane. In fact so important are these advantages that the old type of crane has become obsolete. We have built these cranes in capacity from 175 tons down to 30 tons. The 175-ton cranes are the largest of their kind in the world.

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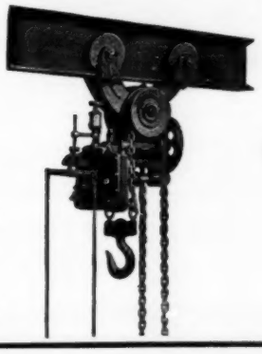
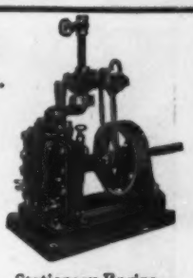
Reversing Steam or Air Motor ½ to 30 hp.





Stationary Engine (2 to 30 hp).

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from laying out the plant to starting it in operation. Our experts know the foundry and its problems from the ground up. Profit by our thirty years' experience.

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are added to the productive value and capacity of this machine and its operator. The lifting time is cut to approximately 15 or 20 seconds and the operator is taking advantage of the Cyclone automatic sustaining brake which really holds the load exactly in position, permitting both hands to guide the work into the machine easily and quickly.

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Booklet B-63 shows many other interesting ways of cutting costs. It's free.

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The Chisholm-Moore Mfg. Co.
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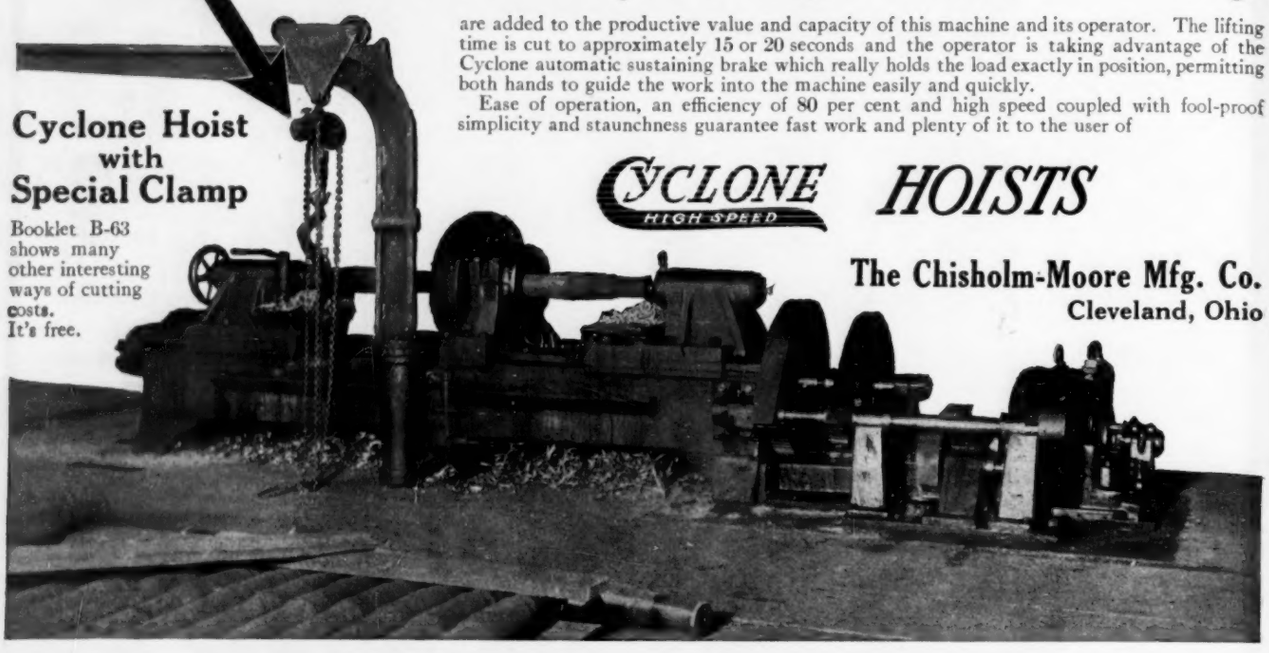

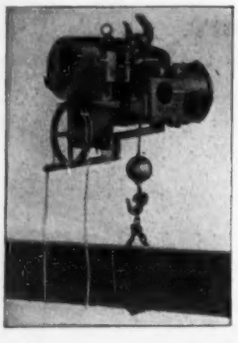

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are especially adapted to mining operations and handle stripping, surface or underground mining and material from stock piles with equal facility. It will pay you to investigate THE THEW carefully. 1200 Thews are now in service, some of them near you.

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For Machine Shops, Foundries, Railway Repair Shops, Shipyards, Lumber and Stone Yards

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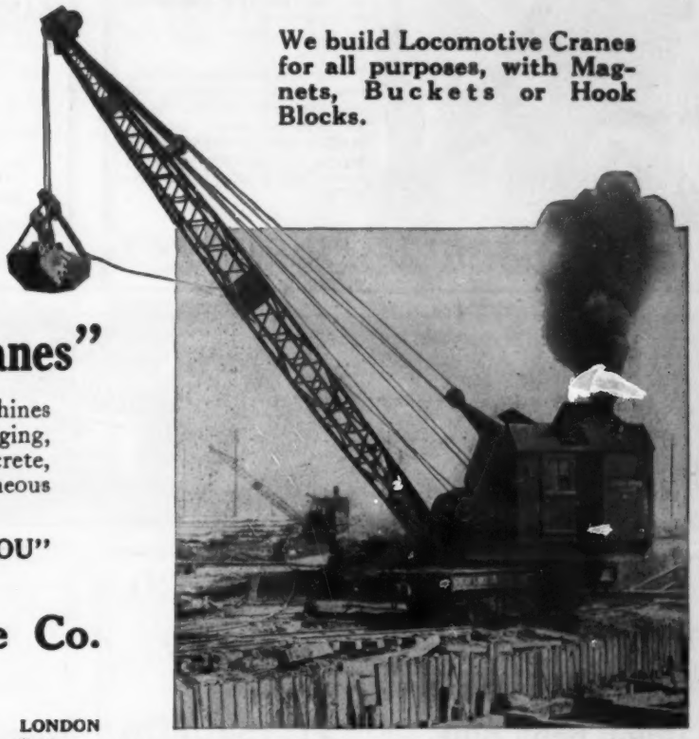

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on the site and since that time these machines have been busy every minute, dredging, handling concrete piles, placing concrete, lifting forms and doing other miscellaneous work.

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If you will write us, we will gladly give you the benefit of our experience.

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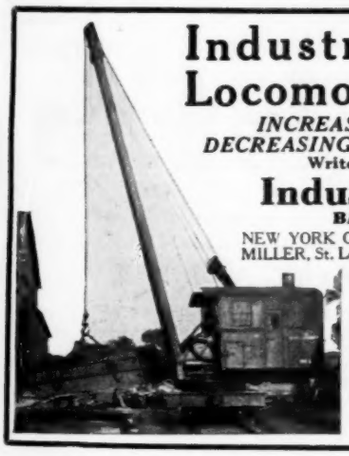

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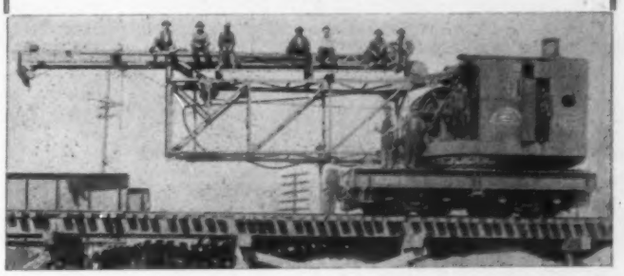

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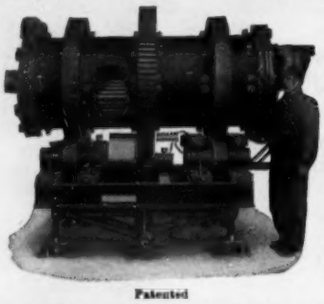

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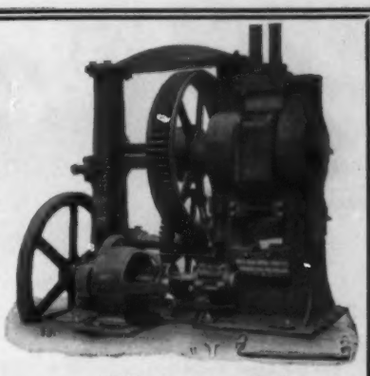

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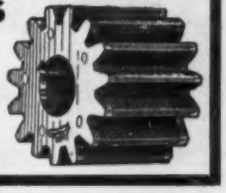

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Peerless Rawhide Pinions are being widely used in many of the largest shops — *because they can always be depended upon to produce desired results.*

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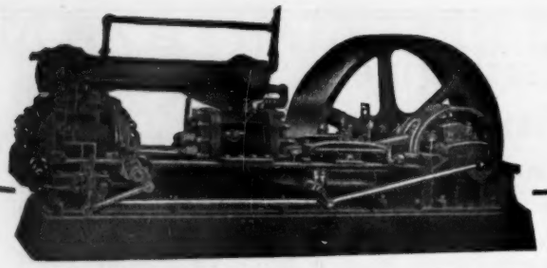

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Large Stocks. Quick Shipments.

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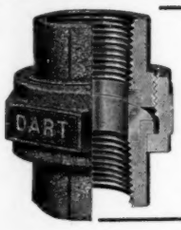

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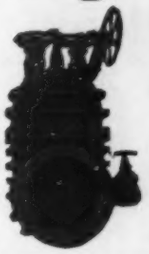

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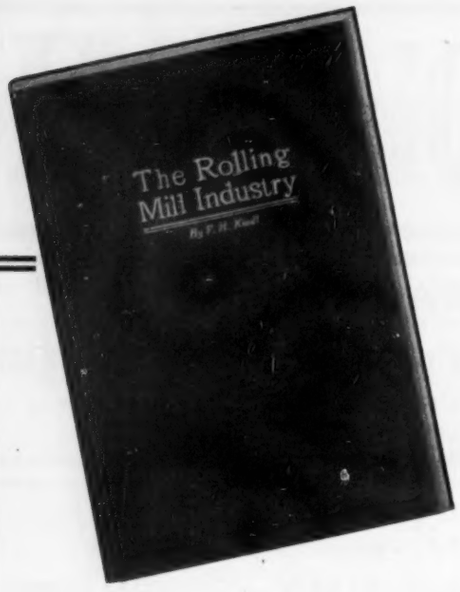

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For those interested in the economics of the iron industry, a table has been prepared in which a comparison has been made of the general fundamental factors dictating the production of pig iron in the United States, Germany and Great Britain, with particular reference to the Pittsburgh district of the United States, the Rheinland-Westfalia district of Germany, and the Cleveland district of Great Britain.

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ABSOLUTELY STORM PROOF

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Unequaled Strength and Wearing Qualities

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We make a SPECIAL HIGH SPEED ALLOY FOR TOOL STEEL

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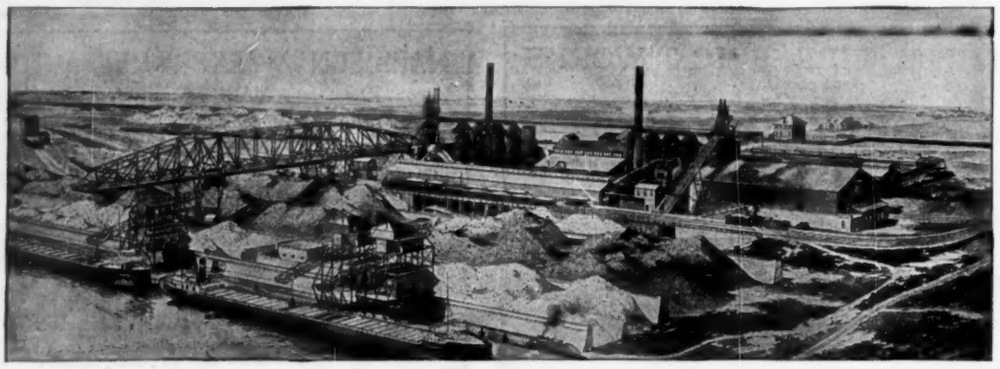

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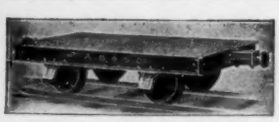

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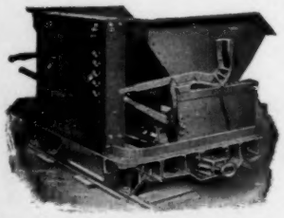

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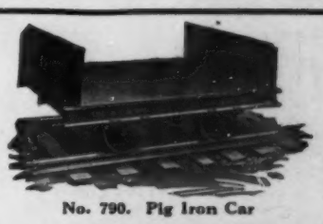

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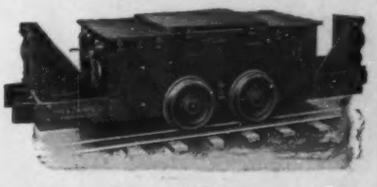

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